4.0 Traffic Impact Analysis

4.1 Summaries of Previous Traffic Studies

4.1.1 Mark Centre Parcel 1A and 1B Traffic Impact Study and Transportation Management Plan, Wells and Associates, March 31, 2003

Scope of Analysis

The study was prepared for the Mark Winkler Company. The purpose of the study was to evaluate the traffic impacts from developing Parcels 1A and 1B, a total of 1,743, 116 square feet of office space by Mark Winkler Company previously approved by City of Alexandria. Traffic impacts from the generated trips on the adjacent roadway network were analyzed and roadway improvements along with TDM strategies were proposed to achieve mobility.

Methodology

The TIS/TMP included the following tasks:

- Conducted traffic counts of adjacent roadway network
- Used ITE trip generation rates for Parcels 1A, 1B and IDA Building based on net square footage of the floor area for office land use; number of employees were not considered
- Projected future traffic without ambient growth adjustment
- Used 10 percent TMP reduction for mode choice
- Distributed trip distribution based on then existing traffic patterns
- Level of service analysis for the existing intersections with and without projected development trips
- Identified TDM strategies to reduce the proportion of single occupancy vehicle trips and to promote transit, shuttle bus, rideshare and flexible work schedules among employees

Based on the level of service analysis of the future traffic demand, the following roadway improvements were identified as necessary to maintain the existing LEVELS OF SERVICE at the signalized intersections,

- Third west bound-to-southbound left-turn lane along Seminary Road at North Beauregard Street
- Second southbound-to-eastbound left turn lane along North Beauregard Street at Mark Center Drive
- Installation of a new traffic signal at the Mark Center Drive/IDA Drive on-site intersection

Study Conclusions

The report concluded that with the implementation of the proposed roadway improvements and 10 percent TMP trip reduction, all study intersections will operate at an acceptable level of service under full build-out and occupancy conditions.

4.1.2 Seminary Road / Beauregard Street Corridor Study, Wilbur Smith Associates, January 19, 2007

Scope of Analysis

The study was completed for the City of Alexandria. The purpose of the study was to identify, analyze, and make short and long term recommendations to address operational and safety issues within the study corridor. The study area included the section of Beauregard Street between Seminary Road and Mark Center Drive.

Methodology

The study utilized a series of neighborhood meetings to identify traffic issues and concerns along the corridor. Vehicle and pedestrian traffic counts were taken to establish baseline conditions. Future conditions assumed office development of Mark Center Parcels 1A and 1B. The traffic forecasts prepared by Wells and Associates, TIMP, March 2003 were used to develop future volumes. Several scenarios of road improvements were evaluated by the study which included widening of Seminary Road and Beauregard Street to allow additional turn lanes.

Study Conclusions

The report concludes with a series of short term (within 2 years) and mid-term (5-10 years) recommendations to improve safety and mobility. Many of the recommendations are focused on improving access by pedestrians and transit users.

4.1.3 I-95/I-395 Transit/TDM Study, TDM Technical Committee, Virginia Department of Rail and Public Transportation, February 29, 2008

Scope of Analysis

This study was made in conjunction with the I-95/ I-395 HOV/Bus/HOT lane project to specifically address transit needs and services within the corridor. The study provides a comprehensive examination of existing transit services within the corridor.

Methodology

A set of alternatives were evaluated based upon a tiered level of investment. The Federal Highway Administration (FHWA) TDM model was used to predict changes in travelers' likelihood to use various modes of travel when offered particular TDM strategies. In other words the study could evaluate strategies to reduce single occupancy vehicles.

Study Conclusions

The study includes an investment strategy to fund the recommended Refined Alternative and Park and Ride Analysis with estimates of anticipated available revenues.

4.1.4 Transportation Improvement Management Plan (TIMP), Wells and Associates, July 30, 2008

Scope of Analysis

Prepared for WHS and Duke Realty Corporation, the study updates and supersedes the March 31, 2003 Traffic Impact Study and Transportation Management Plan approved by the City of Alexandria. The revised TIMP is based on the specific BRAC-133 requirements of the proposed WHS development at the Mark Center site. The TIMP examines the existing intersection levels of service for seven off-site and two on-site intersections; projects future traffic volumes, with and without BRAC 133; estimates BRAC 133 auto-, shuttle bus-, and truck-trips; analyzes future intersection levels of service, with and without BRAC 133; and provides a queuing analysis.

Methodology

The TIMP was based on the following assumptions:

- Traffic counts:
  - Used May 2002 data without ambient growth adjustment
  - Used ITE trip generation rates for IDA Building 5 with a 10 percent TMP reduction.
  - Trip distribution based on then existing traffic patterns
  - Trip generation for WHS facility based three work shifts per day with 83 percent of total employees scheduled for day shift. The trip generation rate is further adjusted 25 percent to discount employees not reporting to work due to illness, vacation or on flex time
  - Of employees reporting to work 60 percent are expected to drive automobile.

- Anticipated improvements for projected LEVELS OF SERVICE:
  - Third west bound-to-southbound left-turn lane along Seminary Road at North Beauregard Street
  - Second southbound-to-eastbound left turn lane along North Beauregard Street at Mark Center Drive
  - Installation of a new traffic signal at the Mark Center Drive/IDA Drive on-site intersection
  - Signal timing optimization

Study Conclusions

- “All signalized intersections are forecasted to operate at LOS “D” or better during both the AM and PM peak hours, with the additional traffic generated by full build out and occupancy of WHS.”
- “Sufficient garage driveway capacity and multiple points of access will be provided to adequately accommodate peak hour traffic expected to be generated by build out and full occupancy of WHS.”

- Mark Center is currently serviced by several mass transit services that provide access to multiple Metrorail stations on three Metrorail lines (Orange, Blue, and Yellow).

4.1.5 I-95/I-395 HOV/Bus/HOT Lanes Interchange Justification Report (IJR), HNTB, January 7, 2009

Scope of Analysis

The IJR was prepared for VDOT for submission to the Federal Highway Administration for approval of a proposed interchange and access modifications to a 36-mile section of I-95/I-395 between Garrisonville Road (Route 610) in Stafford County and Boundary Channel Drive in Arlington County. The project proposes to add a third lane to the existing 28-miles of HOV lanes on I-95/I-395 from South Eads Street near the Pentagon in Arlington County, to their existing southern terminus Route 234 (Dumfries Road) near Dumfries in Prince William County and to convert these lanes to HOV/Bus/HOT lanes. In addition, the project proposes to improve modal interrelationships by adding new direct ramp access from the HOV/Bus/HOT lanes to the GP lanes at eleven (11) locations, one of which is at Seminary Road. The change will allow transit vehicles to use the HOV/Bus/HOT lanes toll free and implement TDM strategies that will improve the interrelationships between GP lanes, HOV/Bus/HOT lanes, mass transit, and ridesharing along the I-95/I-395 corridor.

Methodology

The operational performance of I-95/I-395 was evaluated for three analysis years: existing conditions, opening year (2015) and design year (2030). Raw traffic forecast model data were post processed for future 2015 and 2030 Build and No-Build forecast scenarios on the mainline, HOV/Bus/HOT lanes, ramps, and interchanging crossroad intersections. The post processing of forecast mainline and ramp volumes were based on procedures detailed in *NCHRP 255, Highway Traffic Data for Urbanized Area Project Planning and Design.*

Study Conclusions

The study concluded that the proposed project will relieve congestion at key locations within the improvement limits and meets the justification requirements specified by the FHWA.

4.1.6 Mark Center (BRAC) Transportation Study, Technical Memorandum, Parsons Brinkerhoff (PB), April, 2009

Scope of Analysis

This study was prepared for the Virginia Department of Transportation (VDOT). The purpose of the study was to evaluate the impact of BRAC development at the Mark Center on the surrounding arterials and the I-395 Interchange. The Technical Memorandum provides a critical review of the July 2008 TIMP and includes its own independent traffic analysis of the existing, opening year and 2030 traffic conditions.

Methodology

The PB report analyzed the same seven signalized intersections as the TIMP study. The number of trips generated by the WHS facility was adjusted upward to be consistent with the number of available parking spaces. A 0.5 percent annual growth rate was used for calculating 2030 traffic volumes.

Synchro files were obtained from the City of Alexandria and VDOT and field verified for the analysis.

Study Conclusions

The proposed off site road improvements identified in the TIMP will not be adequate to handle the additional site generated traffic and several of the intersections would operate at LOS E or F. The study suggested that direct access to Mark Center from I-395 is warranted to provide an alternative path and redistribute traffic.

4.1.7 Memorandum - Mark Center Transit Center, Wells and Associates, April 17, 2009

Scope of Analysis

The study reviewed the number of buses that might potentially serve the new Transportation Center on Mark Center Drive.

Methodology

The study examined existing bus routes serving Mark Center and anticipates diversion of WMATA and Dash buses from their present route through the Mark Transportation Center. In addition to public transit the analysis included existing Duke Shuttle trips and estimated WHS shuttle trips.

Study Conclusions

The analysis projected that the Mark Center Transportation Center could potentially be served by 69 buses including public transit vehicles and DoD shuttles during both the AM and PM peak hour.

4.1.8 WHS Internal Roadway Network Traffic Analysis, Wells and Associates, August 20, 2009

Scope of Analysis

This technical memorandum updates an earlier memorandum prepared for Duke Realty which analysis the internal road network serving the BRAC 133 site and the pending WHS building.

Methodology

The trip generation and distribution assumption used for the July 2008 TIMP were used for the internal analysis. Level of service and queue analyses based on the Highway Capacity Manual (HCM) intersection analysis methodology were completed on critical intersections. The analysis also includes an examination of the entry control facility with respect to traffic operations.

Study Conclusions

The study concluded that the proposed roadway network with three ID check stations at the Access Control Point will operate "generally well" during the AM and PM peak hours.

4.1.9 Mark Center (BRAC 133) Transportation Study, Vanasse Hangen Brustlin, Inc. (VHB), November 2, 2009

Scope of Analysis

This study was prepared for the City of Alexandria. It evaluated a series of conceptual alternatives to provide additional access to BRAC 133 site and the parking garage. The VHB study looked at direct access and egress from I-395 to BRAC 133 and the south parking structure in addition to the programmed improvements to the turn lanes on Seminary Road and North Beauregard Street.

Methodology

- Collected new traffic count data to assess weekday AM and PM peak hour traffic
- Alternatives were assessed based on 2013 estimated traffic volumes
- Based on the MWCOG Travel Demand Model an annual growth rate of 0.51 percent was assumed for 2013 traffic volume projections
- Baseline conditions for the trip generation included BRAC 133, IDA, and the 4661 Kenmore Avenue Medical Office Building
- Modeling based on HCM module in Synchro and VISSIM(Version 5.10)

Conceptual Alternatives Evaluated Under Projected 2013 Conditions

- New Ramp to South Parking Garage with and without turn lane improvements
- New Ramp to Mark Center Drive with and without turn lane improvements
- New Ramp to South Garage and Mark Center Drive with and without turn lane improvements
- Additional left turn lanes on westbound Seminary at North Beauregard Street (triple left) and on southbound North Beauregard Street at Mark Centre Drive (double left) without access ramps

Study Conclusions

The turn lane improvements will have little effect on improving the AM and PM peak hour operations. Given continued growth of the corridor, the area would benefit from direct access to the Mark Center Drive from I-395.

4.1.10 Mark Center (BRAC 133) Access Study, Virginia Department of Transportation, December 2009

Scope of Analysis

This study prepared under the direction of VDOT is an operational analysis of the I-395/Seminary Road interchange and surrounding local street network providing access to Mark Center. The study was initiated at the request of the City of Alexandria and the U.S. Army in order to document the impact of the anticipated employment activity in the area primarily resulting from the relocation of 6,409 DoD personnel to BRAC 133 and to identify transportation solutions to mitigate such impacts.

Methodology

The study includes an operational analysis based on current conditions (2009) and as well as projected traffic volumes for 2015 and 1035. The analysis took into consideration programmed intersection improvements at Mark Center as well as the planned HOT lane project on I-395. In addition to the "No-Build" scenario, the study identified seven unique "Build" alternatives that would facilitate access from I-395 to Mark Center. A detailed traffic operations analysis of the no-build scenario and two of the build scenarios are included in the study. The operations analysis utilized both VISSIM and HCS modeling.

Conceptual Alternatives Evaluated

- No-Build Scenario which included programmed intersection improvements, HOT lane improvements, transportation system management improvements as well as TDM strategies incorporated herein
- Alternative A1 – Access to the South Parking Garage via a braided flyover along the existing I-395 southbound ramp
- Alternative D – Access to Mark Center Drive from the I-395 HOT lane via a one-lane, reversible ramp with a connection with a South Parking Garage exit lane

Study Conclusions

The study identified five areas of operational deficiencies under the 2035 No-Build peak traffic conditions. Three of the five involved unacceptable levels of service on the GP lanes on I-395; the fourth affected the signalized "rotary" at the second level of the I-395 and Seminary Road interchange; and the fifth area involved the arterial intersection in the vicinity of the BRAC 133 development. Alternative D was found to produce "better levels of service" for each of the five areas whereas Alternative A1 only improved deficiencies at the arterial intersections with either no improvement or worse levels of services on I-395 and the Seminary Road interchange[34]. VDOT is continuing to evaluate new alternatives to establish a direct ramp access from I-395 South to Mark Center.

4.1.11 Technical Memorandum, Task 4.1: Analysis of Existing and Potential Transit Demand, WMATA, January 2010

Scope of Analysis

The report was prepared under the direction of the WMATA in order to anticipate the effect of eight BRAC sites within the metropolitan Washington region on public transit. Estimates of public transit use at the eight sites were developed for the BRAC deadline year of 2011 and 2020.

[34] *Mark Center (BRAC 133) Access Study, Virginia Department of Transportation, December 2009.*

Methodology

The study used MWCOG's Census Transportation Planning Package with data by Transportation Analysis Zones to estimate the distribution of residence locations by installation personnel and the share of personnel using public transit. When available employee surveys were compared to the TAZ data and adjustments made to the model as to reflect the survey data. At the time of the study no survey data was available and 2006 employee payroll data from the Fort Belvoir EIS was used to estimate the residential distribution of DoD/WHS employees relocating to Mark Center. High and low scenarios were developed based on the amount of employee parking that is planned for the center and assumption regarding the split between car / vanpooling and transit use.

Study Conclusions

The transit mode use is expected to range between 13 and 26 percent. The lower number is based on carpooling and van pooling to be more highly used and is the more likely scenario after the opening of the planned HOV off-ramp to Seminary Road.

4.1.12 Technical Memorandum, Task 4.2: Development of Transit Service Plan, WMATA, January 2010

Scope of Analysis

This report presents service planning concepts for the seven military installations that will gain employees as a result of the BRAC process in the metropolitan Washington region. The discussion of each site begins with a summary of the range of transit demand estimated in Task 4.1. The service planning takes into consideration not only existing service proposals but identifies additional service improvements that may be implemented to accommodate additional transit use as a result of the BRAC initiatives.

Methodology

The study identifies existing transit services available to the gaining sites and describes transit improvements that are being proposed to support additional transit demands. The study did not examine vehicle loads or running times. Further studies will address crowding and reliability issues.

Study Conclusions

A variety of modifications and improvements to the bus routes which would improve transit service for BRAC 133 employees are identified. However, the report concluded that shuttle bus service offered by DoD would provide the most effective connections to the rail network

4.2 Study Area

4.2.1 Streets and Intersections Examined

The traffic analysis study area along I-395 mainline extends north and south of the Seminary Road interchange, inclusive of Seminary Road entrance and exit ramps and ramp influence areas along Seminary Road from Library Lane on the east to North Beauregard Street to the west; and along North Beauregard Street from Seminary Road to Mark Center Drive intersections. Figure 4-1 shows the extents of the traffic analysis study area.

The following signalized and unsignalized intersections that are part of the adjacent roadway network within the study area were analyzed for optimum traffic operations:

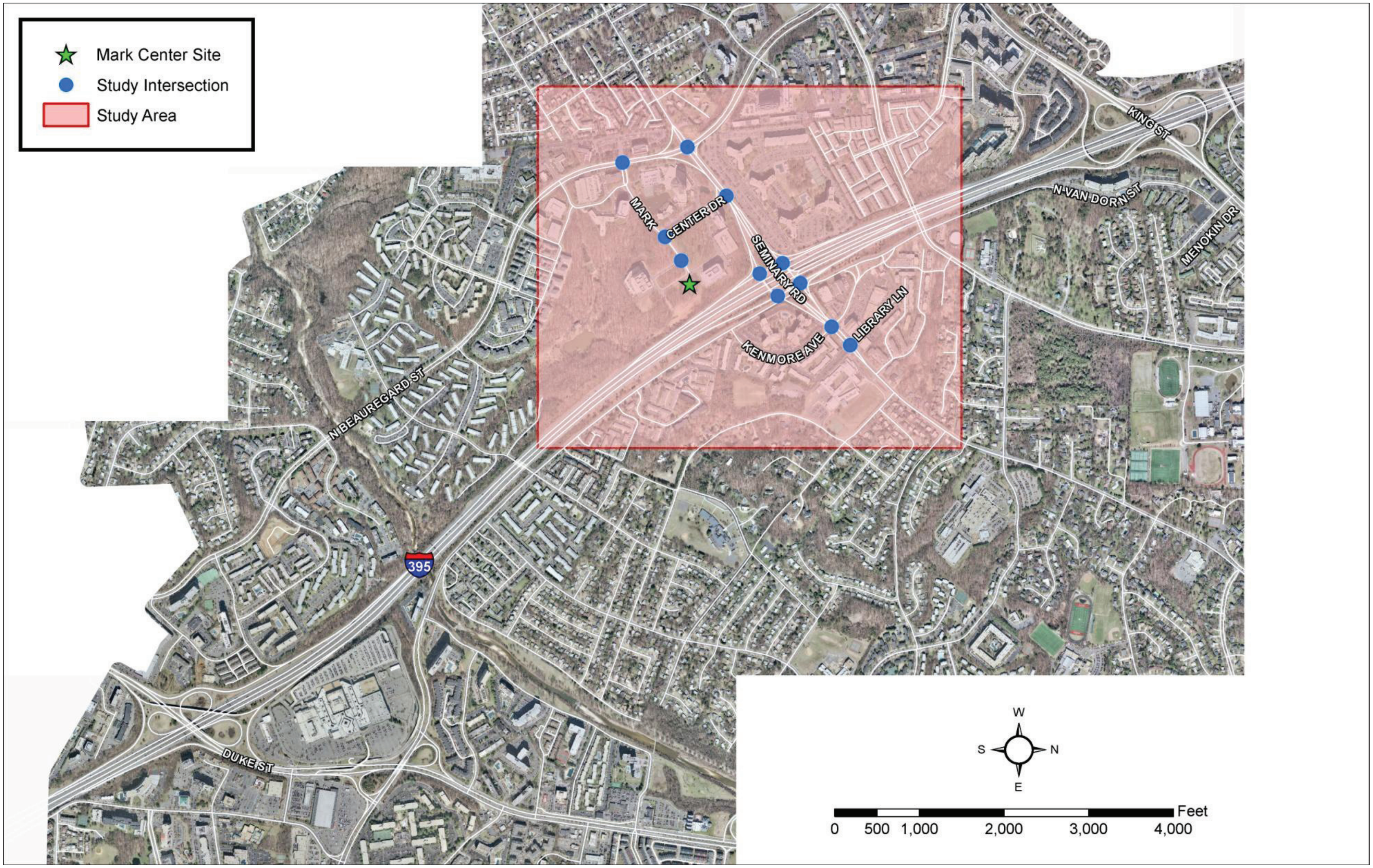
- Seminary Road / Library Lane
- Seminary Road / Kenmore Avenue
- I-395 Northbound Ramps / Seminary Road
- I-395 Southbound Ramps / Seminary Road
- Seminary Road / Mark Center Drive
- North Beauregard Street / Seminary Road
- North Beauregard Street / Mark Center Drive

In addition, the following signalized and non-signalized intersections that are part of the internal roadway network within the study area were also analyzed for optimum traffic operations:

- Mark Center Drive signalized intersection
- WHS Circle/IDA Drive - North Parking Garage roundabout

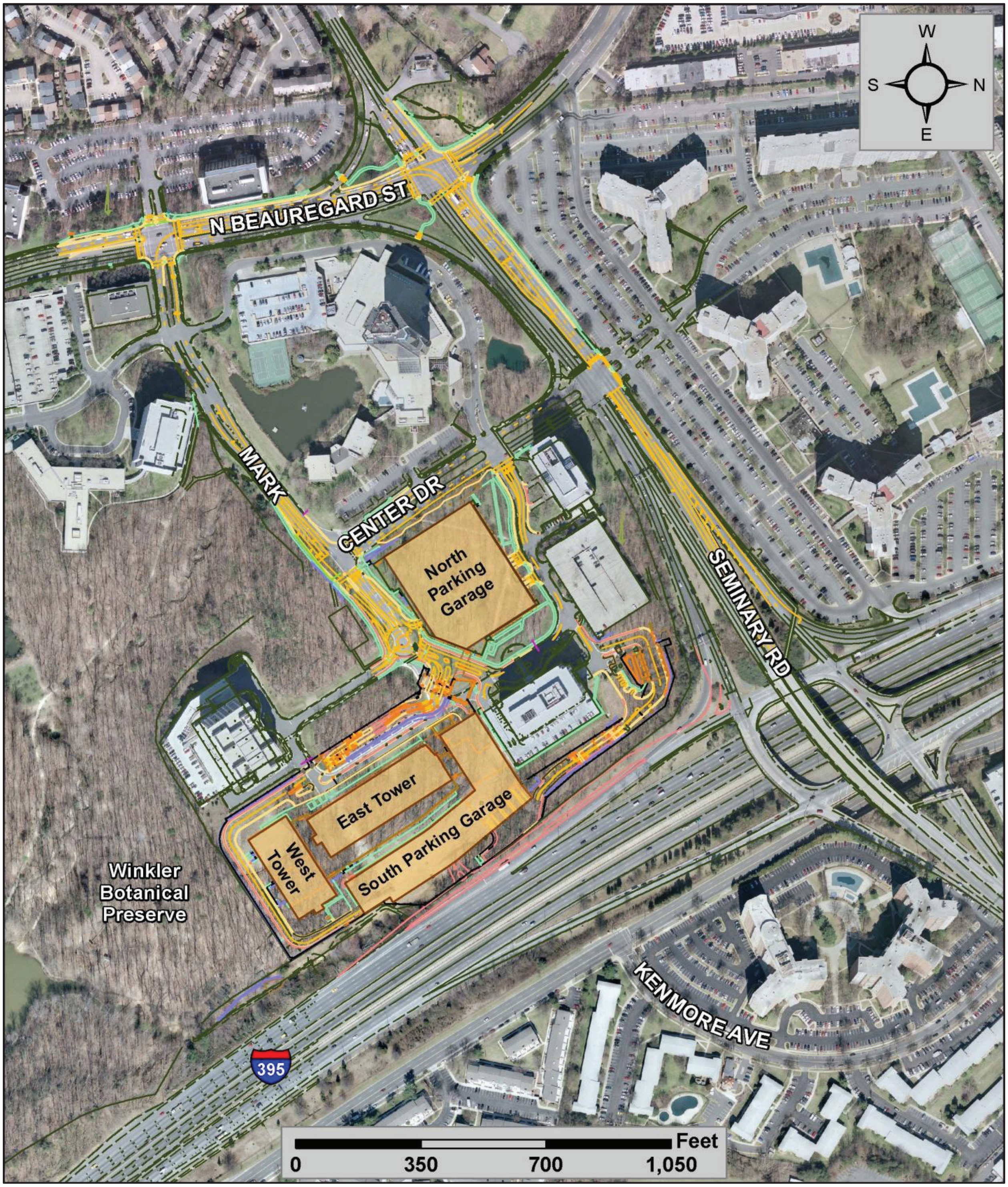
Figure 4-2 shows an overall site plan highlighting the proposed BRAC 133 development and the adjacent roadway network.

Figure 4-1: Traffic Analysis Study Area Extents



Source: ESRI

Figure 4-2: Overall Site Plan



Source: "City of Alexandria GIS DVD," "Overall Site with Improvements" AutoCAD Drawing, USACE, March 01, 2010.

4.2.2 Existing Roadway Conditions

The existing roadway geometry, lane configuration, roadway widths, storage bay lengths, intersection traffic control and signal timing parameters were inventoried and utilized to analyze the existing traffic operations. Figure 4-3 shows the existing lane geometry and traffic control for the study area along with the interim roadway improvements that are currently under construction and scheduled for completion before September 15, 2011[35].

I-395 and Seminary Road Interchange:

I-395 through the study area is a seven-lane GP facility along with two barrier-separated exclusive High Occupancy Vehicle (HOV) lanes to the left side of the GP lanes. The GP lanes are 12 feet wide, with 12-foot wide outside shoulders and 6-foot wide inside shoulders, providing three northbound and four southbound freeway lanes. A full service rotary interchange at Seminary Road allows access from the GP lanes. Existing ramp configurations at the Seminary Road merge and diverge locations are as follows:

- Single lane exit ramp from northbound I-395 GP lanes - 700 foot long deceleration lane
- Double lane entrance ramp to northbound I-395 GP lanes - full auxiliary lane to King Street and 650 foot long acceleration lane
- Double lane exit ramp from southbound I-395 GP lanes - full auxiliary lane from King Street and 100 foot long deceleration lane
- Single lane entrance ramp to southbound I-395 GP lanes - 200 foot long acceleration lane

The I-395 HOV lanes are reversible serving northbound directional traffic demand during the morning peak hour and southbound directional traffic demand during the evening peak hour. I-395 HOV lanes are restricted to motor vehicles with three or more occupants during the peak hour. Transit and shuttle buses serving federal employees are allowed to use the HOV lanes. There is no direct HOV access from I-395 northbound to Seminary Road; however, a single lane HOV ramp with a 450 foot long acceleration (or deceleration) lane allows direct access from Seminary Road to northbound I-395 HOV lanes during the morning peak period, and reversible access from southbound I-395 HOV lanes to Seminary Road during the evening peak period. This HOV access will not benefit the BRAC 133 traffic accessing the Mark Center site from either the north or south directions. The closest I-395 HOV exits to access the Mark Center site in the morning peak hour would be the Springfield exit south of the site and the Pentagon exit north of the site. Drivers exiting the HOV lanes at these locations will have to travel along the northbound and southbound I-395 GP lanes, respectively, to access the site. The HOV lane entry points for vehicles exiting the Mark Center site in the evening peak hour would be the Pentagon entrance to the north of the site and the Duke or Springfield entrances to the south of the site. Drivers entering the HOV lanes at these locations will have to exit the site and travel along the northbound and southbound I-395 GP lanes, respectively, to access the HOV lanes.

The ramp intersections are served by a rotary type interchange with four signalized intersections. These intersections can be coordinated with optimum cycle lengths to facilitate continued traffic flow within

[35] *WHS Transportation Improvement and Management Plan, Wells and Associates, July 30, 2008.*

the rotary and reduce traffic queue buildup within the interchange and along the ramp approaches. The intersection approach lane configurations at the existing rotary interchange are shown in the above figure.

The existing geometry and traffic control features of the study area signalized intersections are shown below in Table 4-1[36]. Adequacy of the existing roadway capacity, lane configurations, storage bay lengths, and signal operations to serve the existing traffic demand are analyzed under existing traffic operations.

[36] Aerial Image and Map Source: "City of Alexandria GIS DVD & Google Earth Imagery".

Figure 4-3: Existing and Proposed External Roadway Lane Geometry

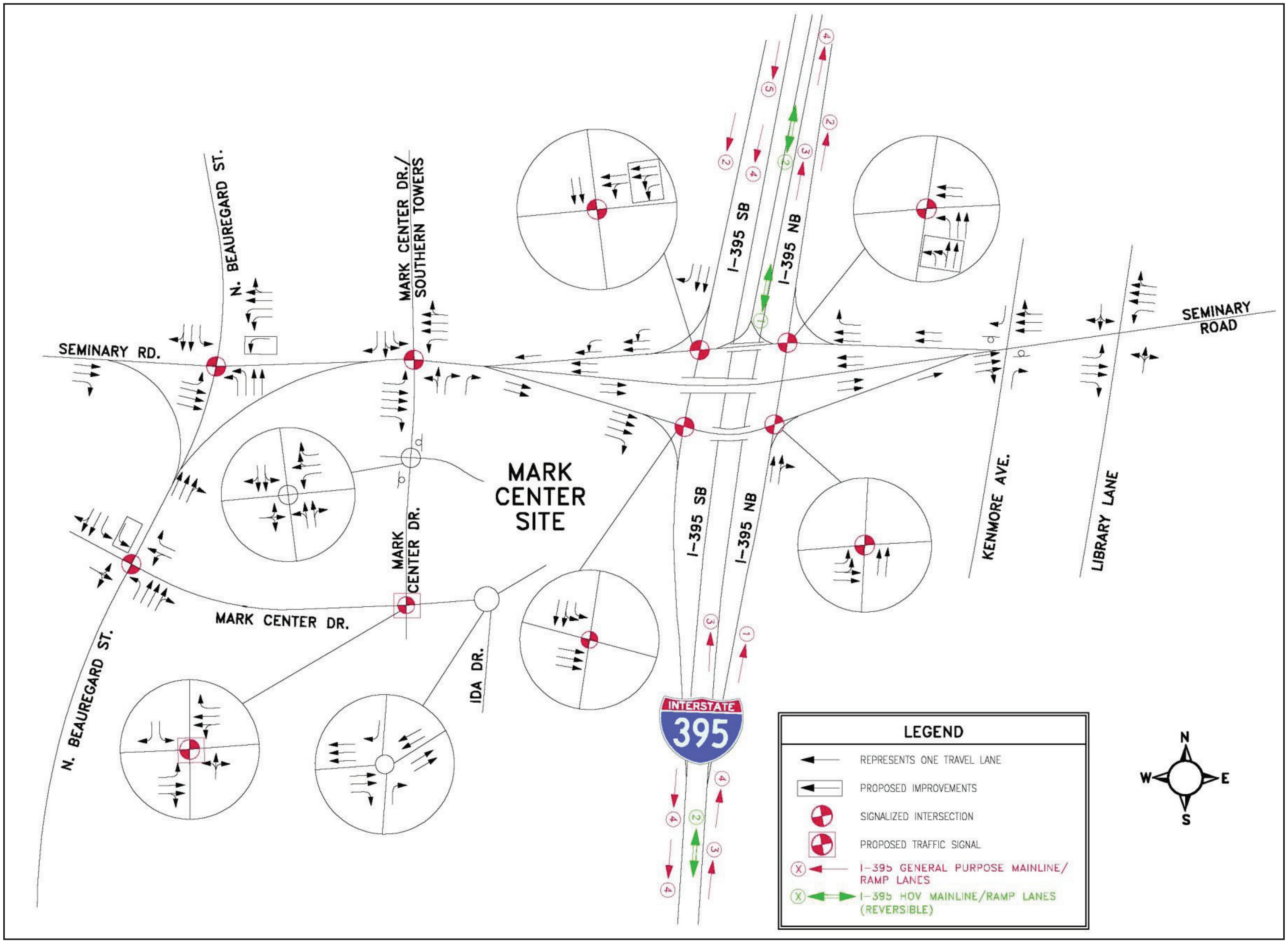


Table 4-1: Existing Roadway and Traffic Control Characteristics at Study Area Signalized Intersections

Intersection	Existing Approach Lane Configuration	Existing Traffic Control Characteristics
Seminary Road and Mark Center Drive	12 ft wide travel lanes, unless otherwise noted Eastbound Approach - one 100 ft left turn bay, three exclusive through lanes, one exclusive free right turn lane from upstream Seminary Road and N. Beauregard Street Westbound Approach - one 120 ft left turn bay, two Seminary Road exclusive through lanes, one I-395 exit ramp movements shared through - right turn lane Northbound Approach - one shared left-through lane, two exclusive right turn lanes Southbound Approach - one exclusive left turn lane, one shared left - through lane and one exclusive right turn lane	• Actuated-Coordinated Controller type • Signal design allows crossing time for vehicular and pedestrian traffic
Seminary Road and N. Beauregard Street	12 ft wide travel lanes, unless otherwise noted Eastbound Approach - one 100 ft left turn bay, one exclusive through lane , one shared through- yield-controlled channelization right turn lane; Approach widens to three exclusive through lanes past the channelized right turn island Westbound Approach - one 200 ft left turn bay, one full left turn lane, one exclusive through lane, one shared through - yield controlled channelized right turn lane Northbound Approach - one 120 ft left turn bay, one full left turn lane, one exclusive through lane, one shared through-free right turn channelized lane Southbound Approach - one 90 ft left turn bay, one exclusive through lane, one shared through - right turn lane	• Actuated-Coordinated Controller type • Signal design allows crossing time for vehicular and pedestrian traffic
N. Beauregard Street and Mark Center Drive	12 ft wide travel lanes, unless otherwise noted Eastbound Approach - one 18 ft wide shared left-through- right turn lane Westbound Approach - one shared left-through lane, one full exclusive right turn lane Northbound Approach - one 150 ft left turn bay, one exclusive through lane , one shared through- right turn lane Southbound Approach - one 80 ft left turn bay, two exclusive through lanes, one shared through - right turn lane	• Actuated-Coordinated Controller type • Signal design allows crossing time for vehicular and pedestrian traffic

4.3 Traffic Volumes

4.3.1 Existing Traffic Volumes

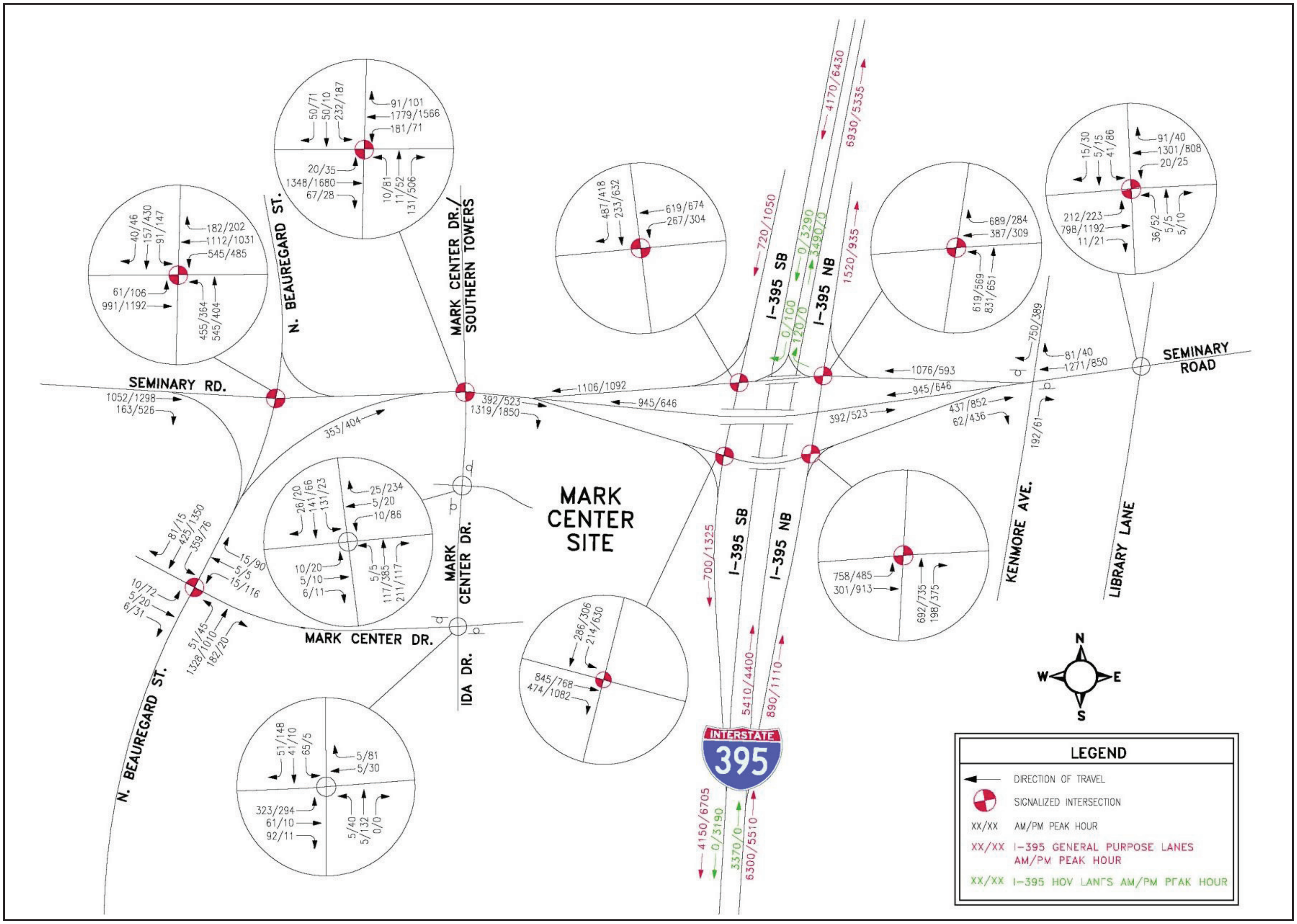
Existing peak hour traffic data (2009) for the study area roadway network including I-395 mainline and ramps, Seminary Road, North Beauregard Street, Mark Center Drive and the roadway intersections were extracted from all prior Mark Center traffic studies and compared. Peak hour is that hour of the day when a roadway or public transport experiences the highest traffic demand. Traffic demand typically peaks once in the morning and once in the evening when most commuters travel. Even though peak periods extend anywhere from one to four hours, for analysis purposes, only the hours experiencing the highest demand in the morning and evening peak periods are used as samples.

After careful review, the reassigned-existing intersection turning movement counts from the *Wells & Associates 2008 Transportation Improvement and Management Plan (TIMP)*[37] were used in conjunction with the *City of Alexandria Mark Center (BRAC 133) Transportation Study* performed by VHB to develop future baseline traffic[38]. Existing traffic volumes and heavy vehicle percentages along I-395 GP and HOV mainline lanes and ramps were obtained from *VDOT's Mark Center (BRAC 133) Access Study Operational Analysis Report (IJR)*[39]. These volumes were balanced to obtain existing 2009 travel demand. Review of the MWCOG travel demand model data conducted by previous studies indicate a half percent annual traffic growth rate for the study area roadway network.[40] This percent was utilized to project the existing 2009 traffic data to obtain baseline 2011 traffic data for the study area. Figure 4-4 shows the baseline traffic volumes for the year 2011 without BRAC growth. Peak hour heavy vehicle data obtained from VDOT's IJR for Mark Center reported a total of five percent trucks along I-395 mainline, with four percent utilizing the GP lanes, and one percent utilizing the HOV lanes.

The existing roadway conditions and 2011 baseline traffic volumes without BRAC growth were utilized to perform baseline traffic operational analysis to identify existing roadway and intersection locations operating at unacceptable levels.

[37] *WHS Transportation Improvement and Management Plan, Wells and Associates, July 30, 2008*.
[38] *Mark Center (BRAC 133) Transportation Study, Vanasse Hangen Brustlin, Inc., November 2, 2009*
[39] *Mark Center (BRAC 133) Access Study Operational Analysis Report, VDOT web site* http://www.vamegaprojects.com/faqsdocuments/mark-center-documents (last accessed May 1, 2010).
[40] *Mark Center (BRAC 133) Transportation Study, Vanasse Hangen Brustlin, Inc., November 2, 2009* & Mark Center (BRAC) Transportation Study, Technical Memorandum, Parsons Brinkerhoff (PB), April, 2009.

Figure 4-4: Re-distributed 2011 Baseline Traffic Volumes without BRAC Growth



Data Source: WHS Transportation Improvement and Management Plan, Wells and Associates, July 30, 2008; Mark Center (BRAC 133) Transportation Study, Vanasse Hangen Brustlin, Inc., November 2, 2009; Mark Center (BRAC 133) Access Study Operational Analysis Report.

4.3.2 Projected Traffic Volumes

The projected trips identified in Section 2.3 were used in the determination of morning and evening peak hour trips and distribution of the projected peak hour trips along the existing adjacent roadway network roadway to determine projected traffic volumes for the 2011 build out condition. The morning and evening peak periods with the highest demand were identified from the fall 2009 WHS employee commute survey results along with the peak hours of travel during those periods. The travel patterns of the BRAC 133 employees indicate the morning peak period to the site extending from 6:00 AM to 9:00 AM with the highest peak hour demand occurring between 7:00 AM to 8:00 AM. The evening peak period extends from 3:00 PM to 6:00 PM with the highest peak hour demand occurring between 4:00 to 5:00 PM. The SOV trips including employee and visitor trips, and rideshare vehicle trips were distributed along the morning and evening peak periods of travel. Table 4-2 and Table 4-3 show the traffic distribution of the site generated trips for the morning and evening peak periods. The highest traffic demand from the morning and evening peak hours were used for trip distribution.

Table 4-2: Projections of Peak Hour BRAC 133 Employee and Visitor SOV and Rideshare Trips – AM Peak Period

Employee Occupancy	Total Number of Employees	57% Employee SOV Trips	Total Number of Visitor SOV Trips	11% Employee Rideshare Trips	AM Peak Period Trips				
					Hourly Trip Distribution	Peak Hour	Employee	Visitor	Rideshare
100% Occupancy	6409	3653	83	231	5%	5-6 am	183	4	12
					27%	6-7 am	986	22	62
					39%	7-8 am	1425	32	90
					24%	8-9 am	877	20	55
					5%	9-10 am	183	4	12
95% Occupancy	6089	3470	79	219	5%	5-6 am	174	4	11
					27%	6-7 am	937	21	59
					39%	7-8 am	1353	31	86
					24%	8-9 am	833	19	53
					5%	9-10 am	174	4	11
90% Occupancy	**5768**	**3288**	**75**	**208**	5%	5-6 am	164	4	10
					27%	6-7 am	889	20	57
					39%	**7-8 am**	**1282**	**29**	**81**
					24%	8-9 am	789	18	50
					5%	9-10 am	164	4	10
85% Occupancy	5448	3105	71	196	5%	5-6 am	155	4	10
					27%	6-7 am	838	19	53
					39%	7-8 am	1211	28	77
					24%	8-9 am	745	17	47
					5%	9-10 am	155	4	10

NOTE: (1) Refer to Section 2: Table 2-4 "Trip Projection of Mark Center Employees with Projected Mode Split".

(2) Assumes that the number of visitors per day is equivalent to 5% of the number of employees present on a typical day (as per previous Mark Center traffic studies). Assumes uniform visitor arrival rates throughout the day. Mode split for visitors was assumed to be the same as that of employees. Visitors attending conferences, seminars, and meetings at must conform to the parking protocol described in Section 5.4.4.

(3) Employee rideshare trips include trips generated by carpool and vanpool modes.

Table 4-3: Projections of Peak Hour BRAC 133 Employee and Visitor SOV and Rideshare Trips – PM Peak Period

Employee Occupancy	Total Number of Employees	57% Employee SOV Trips	Total Number of Visitor SOV Trips	11% Employee Rideshare Trips	PM Peak Period Trips				
					Hourly Trip Distribution	Peak Hour	Employee	Visitor	Rideshare
100% Occupancy	6409	3653	83	231	4%	2-3 pm	146	3	9
					21%	3-4 pm	767	17	48
					37%	4-5 pm	1352	31	85
					28%	5-6 pm	1023	23	65
					10%	6-7 pm	365	8	23
95% Occupancy	6089	3470	79	219	4%	2-3 pm	139	3	9
					21%	3-4 pm	729	17	46
					37%	4-5 pm	1284	29	81
					28%	5-6 pm	972	22	61
					10%	6-7 pm	347	8	22
90% Occupancy	**5768**	**3288**	**75**	**208**	4%	2-3 pm	132	3	8
					21%	3-4 pm	690	16	44
					37%	**4-5 pm**	**1216**	**28**	**77**
					28%	5-6 pm	921	21	58
					10%	6-7 pm	329	7	21
85% Occupancy	5448	3105	71	196	4%	2-3 pm	124	3	8
					21%	3-4 pm	652	15	41
					37%	4-5 pm	1149	26	73
					28%	5-6 pm	869	20	55
					10%	6-7 pm	311	7	20

NOTE: (1) Refer to Section 2: Table 2-4 "Trip Projection of Mark Center Employees with Projected Mode Split".

(2) Assuming that the number of visitors per day is equivalent to 5% of the number of employees present on a typical day (as per previous Mark Center traffic studies). Uniform visitor arrival rates were assumed throughout the day. Mode split for visitors was assumed to be the same as that of employees. Visitors attending conferences, seminars, and meetings at must conform to the parking protocol described in Section 5.4.4.

(3) Employee rideshare trips include trips generated by carpool and vanpool modes.

The BRAC 133 site-generated employee and visitor trips were combined with the proposed IDA Building generated trips to obtain the overall generated trips to the future Mark Center location. The incoming and outgoing vehicle percentages were obtained from the *Wells & Associates 2008 TIMP*[41]. Table 4-4 shows the total BRAC 133 and IDA generated trips and the incoming and outgoing split for the AM and PM peak hour. Trips generated by BRAC 133 include those of employees, contractors, and other support personnel such as security staff, maintenance personnel, building management, and other support staff. To account for shift workers, and employees departing the site for meetings, a small percent of trips have been assumed to exit the site during the morning peak hour and enter the site during the evening peak hour. This is in alignment with Institute of Transportation Engineers recommended directional distribution for an office park and in conformity with all the prior Mark Center traffic studies.

Table 4-4: BRAC 133 and IDA Building Site-Generated Trips

90% Typical Day Shift Employee Occupancy	AM Peak Hour Trips			PM Peak Hour Trips		
	IN	OUT	TOTAL	IN	OUT	TOTAL
	95%	5%	100%	10%	90%	100%
BRAC 133 Employee SOV Trips	1218	64	1282	122	1094	1216
BRAC 133 Visitor SOV Trips	27	2	29	3	25	28
BRAC 133 Rideshare Trips	77	4	81	8	69	77
Other Site Generated trips[1]	32	2	34	3	30	33
Proposed DOD / WHS Shuttles[2]	30	30	60	30	30	60
Truck Trips[3]	4	4	8	4	4	8
Sub-Total	**1388**	**106**	**1494**	**169**	**1253**	**1422**
IDA Building 5 SOV Trips[3,4]	413	57	470	74	359	433
TOTAL	**1801**	**163**	**1964**	**243**	**1612**	**1855**

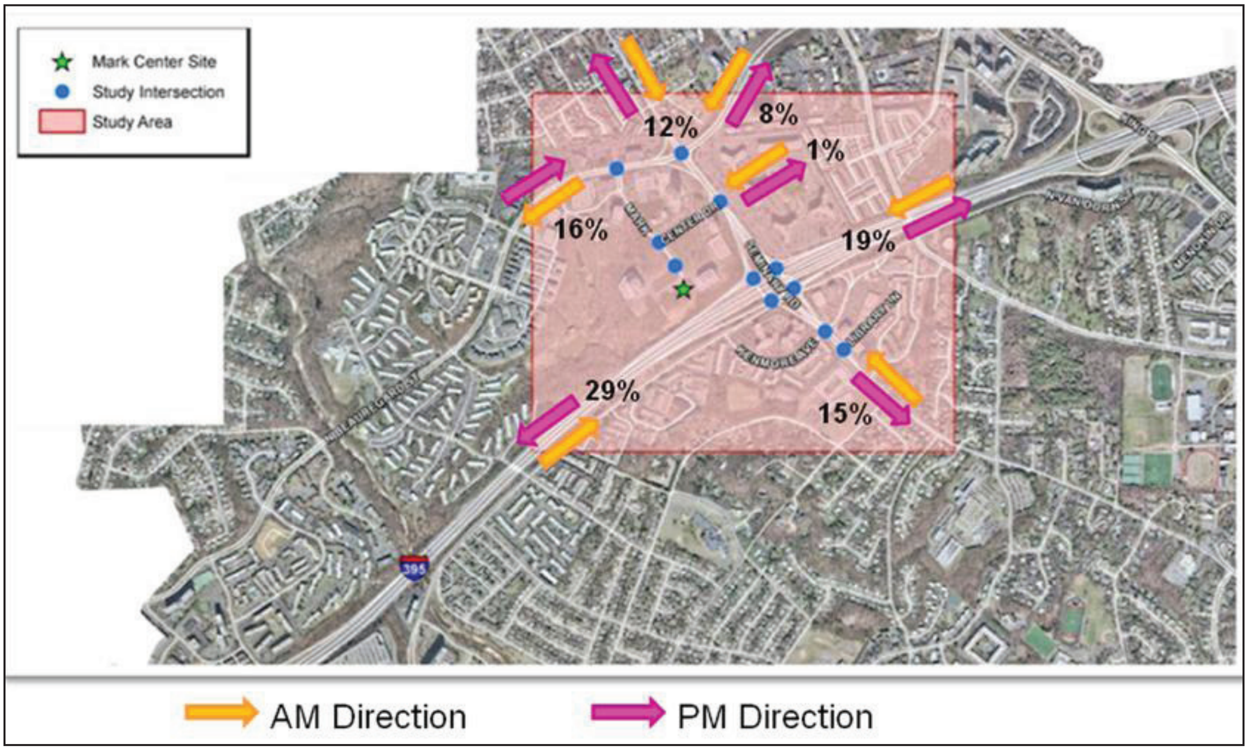
NOTE: (1) Includes other federal and non-federal employees accessing the site comprising of security staff, maintenance personnel, building management and other service staff who would access the site on any typical day. A total of 150 other personnel are estimated to access the site. Projected mode split shown in Section 2.3.2 representative of the entire building population was used.
(2) Based on proposed DOD WHS Shuttle Plan Alternative 1: Operates five routes (Ballston, Pentagon, King St, East Falls Church, West Falls Church) at 10-minute headways during the peak hour, as received on April 10, 2010. See Section 3 for the most recently updated DOD shuttle plan.
(3) BRAC 133 Transportation Improvement and Management Plan (TIMP), Wells & Associates, July 2008.
(4) Institute of Transportation Engineers Trip Generation Manual recommendations for an Office Park per 1000 Sq. Feet Gross Floor Area for 368,400 Sq. Feet.

The total site-generated trips were distributed based on the origin zip codes, existing travel patterns, future transit riding potential dependent on transit corridors adjacent to origin points, and future rideshare prospects along high density zip code clusters. The total SOV and rideshare trips generated from all Virginia locations, Washington D.C., and Maryland were distributed to routes along the existing roadway system within the City of Alexandria and to the Mark Center site from the north, south, east and west via I-395, Seminary Road and North Beauregard Street corridors. (Appendix B shows employee population density maps by home zip codes.) Based on the home zip codes, it was determined that most of the trips originating from north and south directions will travel along I-395, and access the site

[41] *Mark Center Parcel 1A and 1B Traffic Impact Study and Transportation Management Plan, Wells & Associates, March 31, 2003.*

at Seminary Road interchange. Figure 4-5 shows the BRAC 133 traffic distribution along the existing roadway network and their directions of travel.

Figure 4-5: BRAC 133 Trip Distributions along Existing Roadway Network



The projected Mark Center trips were internally distributed based on the percentage splits obtained from the *Wells & Associates 2008 TIMP* and the *WHS 2009 Internal Roadway Network Study*. Figure 4-6 shows the distribution of the BRAC 133 and IDA generated SOV, rideshare, and shuttle trips along the study area roadway network. Rideshare trips originating from the south along I-95/I-395 were assumed to use the GP lanes for projected traffic demand estimation purposes. However, there is a possibility that some or all of the northbound rideshare vehicles will use the I-95/I-395 HOV lanes, exit at the Pentagon, and turn around to travel along I-395 southbound GP lanes to Mark Center. The rideshare trips and shuttle buses originating from the north, and traveling southbound on I-395 will use the GP lanes, since the HOV lanes during the morning peak period serve only the northbound traffic. The projected trips were combined with the existing baseline trips to obtain the total future trips accessing the Mark Center site. Figure 4-7 shows the projected traffic volumes at build-out on opening day (2011), including baseline trips, and WHS and IDA generated SOV, rideshare, and shuttle trips along the study area roadway network. This projected traffic demand in combination with the proposed interim roadway improvements (as listed in Section 3.2.2) were added to the existing roadway network to determine the future traffic operations (levels of service) along the adjacent roadway network to Mark Center site.

Figure 4-6: BRAC & IDA Generated Peak Hour Trips

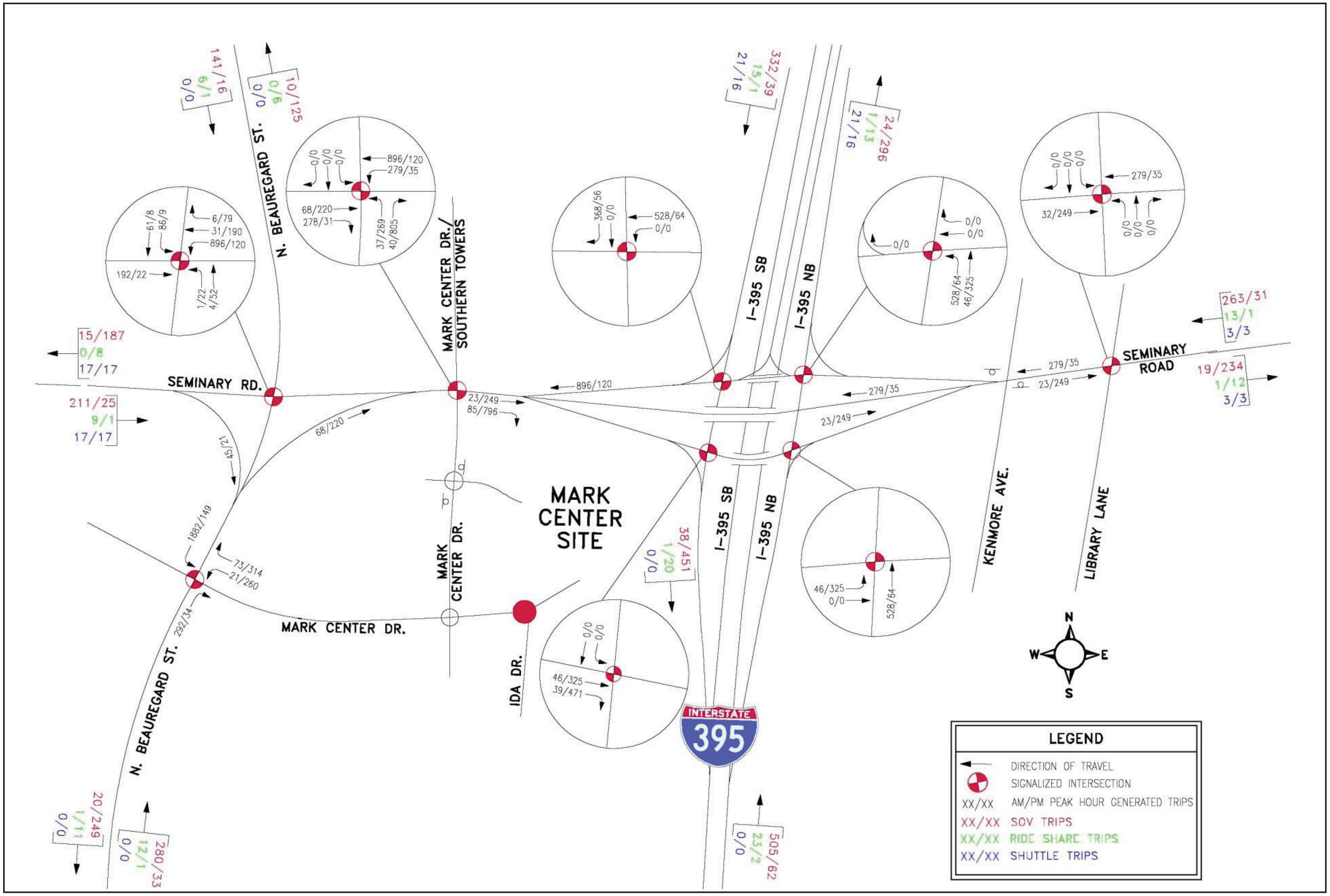
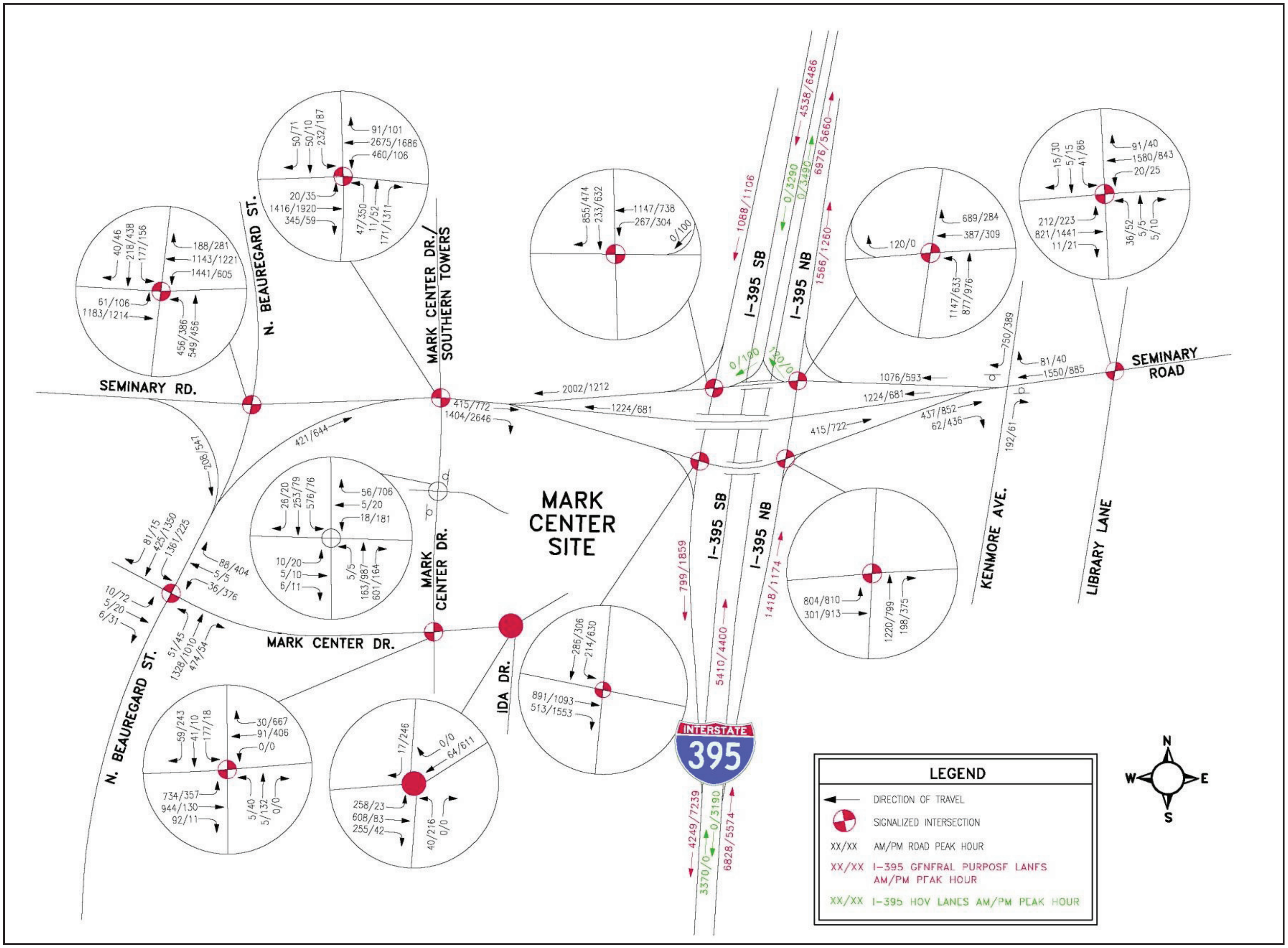


Figure 4-7: Projected (2011) Peak Hour Traffic Volumes (Baseline/BRAC 133/IDA Trips)



4.4 Traffic Operations

4.4.1 Simulation Modeling

Traffic operational analysis and micro simulation modeling for the overall study area was performed using TSIS-CORSIM software version 6.2. Existing and proposed site conditions under the baseline and projected traffic demand were performed and analyzed. Synchro, a macroscopic design software, was used to optimize signal timing and coordination for all the signalized intersections within the study area. The data obtained from the optimized Synchro traffic signal design model was then transferred to CORSIM to obtain the overall model operating under optimum conditions.

Synchro is a macroscopic signal design software based on the Highway Capacity Manual (HCM) recommended guidelines for signalized intersections. Synchro is a location-based analysis tool and is not used to model interactions between vehicles within the traffic stream. Synchro models traffic arriving or present at the intersection approaches and does not account for traffic flow or spillback conditions at adjacent intersections. Thus, CORSIM, a microscopic simulation model was used to accurately determine the traffic operations of the roadway network.

CORSIM is a time-based stochastic simulation model used to effectively simulate combined arterial and freeway traffic operations. CORSIM analyzes both the freeway (FRESIM) and arterial (NETSIM) elements of the study area to provide a detailed review of the overall traffic operations and problem locations. CORSIM accounts for individual vehicle travel patterns, lane changing behavior, adjacent intersection operations and its effect on upstream or downstream intersections. Comprehensive system and link measures of effectiveness (MOEs) can be collected for each vehicle entering the network for every second of model simulation. The link MOEs provide information for any part of the roadway network within the study area. The simulation model can be viewed using TRAFVU to study the traffic flow, queues and spillback effects. Because of the stochastic nature of the model, each simulation run results provide only an estimation of the model's true characteristic. Multiple simulations performed with varying random seeds provide an accurate representation of the network performance.

The overall CORSIM model developed for the study area includes the roadway extents and intersections as outlined previously in Section 4.2.1. The traffic model includes transit bus stations, transit bus routes and shuttle bus routes that currently exist within the study area extents. The model also integrates the proposed DoD shuttle plan (as of April 2010) along with the shuttle routes and shuttle trip headways.

4.4.2 Data Assumptions and Study Area Models

The model development process included compilation of all available data and CORSIM network coding to prepare the model for various analysis scenarios. The existing 2009 model was developed for morning and evening peak hours based on traffic volume and signal timing data obtained from the *City of Alexandria Mark Center (BRAC 133) Transportation Study* performed by VHB. Site observations were conducted to perform model verifications to improve the CORSIM model prior to developing models for future analysis scenarios. The existing 2009 morning and evening peak CORSIM models were refined and the default values revised where necessary, to ensure that the model throughputs matched actual traffic counts and the model generated queues reflected representative queues observed in the site.

Appendix F includes tables that present the Measures of Effectiveness for the critical freeway mainline and ramp sections and intersections within the study area for the existing 2009 morning and evening peak hour conditions. Details of the model assumptions and default value modifications that were made to refine the base models are elaborated below.

The Erlang distribution type with and Erlang distribution shape parameter value of one (1) was used for vehicle entry headways.

CORSIM does not allow actuated-coordinated type controls for multiple intersections controlled by one master controller. To obtain optimum interchange performance, the ramp terminal intersections at the Seminary Road rotary interchange were modeled as actuated-uncoordinated type controls, with the signal phasing and timing calibrated to simulate coordination conditions. Optimized signal timing and coordination plans were used in developing the 2011 baseline traffic models without BRAC improvements.

A 30 to 80 second dwell time was assumed for bus transit and shuttle bus vehicles traveling through the modeled roadway network. The lower range of dwell times were allotted to transit vehicles that did not have exclusive bus bays and stopped along the traffic lanes blocking the through traffic operations.

CORSIM assumes a 100 percent possibility of a vehicle discharging and joining a spillback during queue overflow and spillback from downstream intersections. The default factors were adjusted to assume zero probability of vehicles discharging and joining a spillback. MUTCD recommended "Do Not Block Intersection" (R10-7) signs should be installed along BRAC 133 internal roadway network at intersection crossings, especially at exit points from parking garages to reduce the likelihood of traffic from joining queues and obstructing other intersection approaches from discharging.

CORSIM assumes that 50 percent of the drivers within any modeled traffic network cooperating with a lane-change behavior will slow down to allow a lane change to occur in front of them. This default value was modified based on site observations to show 60 percent of drivers cooperating with a lane change maneuver. Existing conditions indicate that drivers are more cognizant of the various lane change maneuvers occurring along Seminary Road and North Beauregard Street, and in fact slow down to let other drivers change lanes in front of them.

Even though CORSIM does not explicitly model roundabout movements, it can be used to indirectly model one by accurately coding the traffic movements through the roundabout to their destination nodes, and by modifying gap acceptance parameters for driver types. The proposed roundabout at WHS Circle/IDA Drive - North Parking Garage was modeled in CORSIM. The default right turn gap acceptance parameters within the NETSIM setup were modified for the various driver types to accurately reflect gap acceptance behaviors at roundabouts. Table 4-5 shows the modifications to the gap acceptance parameters for various driver types.

Table 4-5: Modifications to Driver Gap Acceptance Parameters for NETSIM Right Turns

Parameters	Random Driver Type From Least Aggressive Driver to Most Aggressive Driver									
	1	2	3	4	5	6	7	8	9	10
CORSIM Default Gap Acceptance	10.0	8.8	8.0	7.2	6.4	6.0	5.6	5.2	4.8	3.6
Modified Gap Acceptance for Roundabout Behavior	8.1	6.9	6.1	5.3	4.5	4.1	3.7	3.3	2.9	1.7

The refined CORSIM models were used to generate future analysis scenario models that helped identify the impacts of the projected growth. Micro simulation models of the study area were developed for two future analysis scenarios under the morning and evening peak hour traffic demands as shown below:

- Baseline (2011) Traffic Demand without Improvements
- Projected (2011) Traffic Demand with Interim Improvements

The traffic analysis includes operations of I-395 mainline and ramps at the Seminary Road interchange only and does not account for any potential adverse operations initiated by traffic queues or other operational impediments extending from the adjacent Duke Street and King Street interchanges. It is to be noted that traffic spillback extending from any upstream or downstream weaving sections and/or bottlenecks can severely degrade the interchange operations at I-395/Seminary Road, along with the operations of the ramp terminal intersections and cross street corridor. The existing conditions along northbound I-395 GP lanes indicate moderate to high congestion (LOS D - LOS E) between Duke Street and King Street interchanges during the morning peak hour, and light to moderate traffic (LOS B - LOS C) during the evening peak hour. The existing conditions along southbound I-395 GP lanes indicate light to high congestion (LOS C - LOS E) between Duke Street and King Street interchanges during the morning peak hour, and light to severe congestion (LOS C - LOS F) during the evening peak hour[42]. An overall analysis of the I-395 corridor including adjacent interchanges should be performed to accurately identify the operational impacts. Table 4-6 shows some of the traffic flow parameters used in developing the simulation models for the Mark Center traffic analysis.

[42] *Mark Center (BRAC 133) Access Study Operational Analysis Report, VDOT web site* http://www.vamegaprojects.com/faqsdocuments/mark-center-documents (last accessed May 1, 2010).

Table 4-6: Traffic Flow Parameters used in the CORSIM Model

Roadway	Free Flow Speed	Truck %	Lane widths
I-395 GP Mainline	65 mph	4%	12 ft
I-395 HOV Mainline	70 mph	1%	12 ft
I-395 Entrance Ramps	35 mph	2%	15 ft
I-395 Exit Ramps	35 mph	2%	15 ft
Seminary Road	35 mph	2%	12 ft
N Beauregard Street	35 mph	2%	12 ft
Mark Center Drive	25 mph	2%	12 ft

4.4.3 Transit Routes and Schedules

Existing public bus transit and shuttle bus routes and their service schedules within the study area were reviewed and summarized for morning and evening peak period and peak hour trips, route origin and destination points and bus stop locations. This data was coded in the traffic simulation model to accurately reflect the vehicle flow and vehicular interactions within the roadway network. Public bus transit service through the region is offered by DASH, and WMATA. Duke Realty Corporation, IDA, and CNA operate private shuttle bus service between Mark Center and the Pentagon Metrorail Station during hours for their tenant organizations. The proposed DoD shuttle bus trips to serve BRAC 133 were also included as part of the 2011 projected traffic simulation model (See Section 3.3.1 for details on existing public bus transit serving Mark Center and Appendix C for all the existing public transit bus routes).

Table 4-7 summarizes the bus routes and service trips that were included in the traffic simulation model. This table is different from that in Section 3, in that it shows all the buses including public transit and shuttles utilizing roadway networks in the study area whereas Table 3-1 summarizes buses that directly serve BRAC 133 employees within a half mile walking distance.

Table 4-7: Schedule and Routes of Bus Transit and Shuttle Bus Services adjacent to BRAC 133

Transit Agency	Route Number	Route Connection	Direction of Travel	Morning Peak Period 6:00 - 9:00 AM				Evening Peak Period 3:00 - 6:00 PM			
				Total # of Bus Trips	AM Peak Hour Trips	Peak Hour Headway (min)	Peak Hour Offset (min)	Total # of Bus Trips	PM Peak Hour Trips	Peak Hour Headway (min)	Peak Hour Offset (min)
DASH[1]	AT1	Van Dorn / Eisenhower Metro - Seminary Plaza	Northbound	7	2	25	19	7	2	25	14
			Southbound	7	2	30	28	7	2	30	28
DASH	AT2	Lincolnia (Landmark Mall) - King Street / Braddock Metro	Eastbound	9	3	17	11	7	2	30	5
			Westbound	7	2	30	15	9	3	20	12
WMATA[2]	7A,7F	Lincolnia - North Fairlington Line / Pentagon Metro	Northbound	0	0	-	-	6	2	29	23
			Southbound	6	2	25	21	2	0	-	-
WMATA	7W,7X	Lincolnia - North Fairlington Line / Pentagon Metro	Northbound	20	11	5.5	4	0	0	-	-
			Southbound	0	0	-	-	14	6	10	0
WMATA	16L	Annandale - Skyline City - Pentagon Metro	Eastbound	2	2	30	0	0	0	-	-
			Westbound	0	0	-	-	1	1	60	0
WMATA	25B	Landmark - Ballston MU	Northbound	6	2	30	26	6	2	30	5
			Southbound	6	1	30	25	6	2	30	5
WMATA	28A	Alexandria / King Street Metro - Tysons Corner	Eastbound	6	2	30	26	6	2	30	7
			Westbound	6	2	30	7	6	2	30	20
WMATA	28F	Skyline City - Pentagon Metro	Northbound	0	0	-	-	7	2	25	18
			Southbound	6	2	25	11	0	0	-	-
WMATA	28G	Skyline City - Pentagon Metro	Northbound	8	2	25	14	0	0	-	-
			Southbound	0	0	-	-	8	3	20	5
IDA/CNAC[3]	Shuttle	Pentagon Metro - Mark Center	-	12	4	15	0	12	4	15	0
Duke[4]	Shuttle	Pentagon Metro - Mark Center	-	21	10	6	0	11	5	12	0
Proposed DoD Shuttle Plan[5]	Shuttle	Pentagon Metro - Mark Center	-	18	6	10	0	18	6	10	0
		King Street Metro - Mark Center	-	18	6	10	0	18	6	10	0
		Ballston Metro - Mark Center	-	18	6	10	0	18	6	10	0
		East Falls Church - Mark Center	-	18	6	10	0	18	6	10	0
		West Falls Church - Mark Center	-	18	6	10	0	18	6	10	0

NOTE:

(1) WMATA bus schedule data obtained from http://www.wmata.com Metrobus Virginia Timetables

(2) DASH bus schedule data obtained from http://www.dashbus.com DASH system maps routes and schedules

(3) IDA/CNAC shuttle schedules obtained from WHS

(4) Duke shuttle schedules obtained from Mark Center Express flyer

(5) Based on proposed DoD shuttle plan Alternative 1 - obtained from WHS April 10, 2010. See Section 3 for the most recently updated DoD Shuttle Plan.

4.4.4 Traffic Operational Measures of Effectiveness

Traffic operations of the transportation elements are usually defined in terms of LOS with the designations ranging from LOS A to LOS F. LOS A indicates free flow and LOS F indicates forced flow or breakdown conditions. The level of service of the various transportation elements are defined in terms of varying measures of effectiveness pertinent to the functional classification of the facility.

Traffic flow conditions and levels of service of freeway mainline and ramps are usually measured in terms of density expressed in vehicles per mile per lane (vpmpl). Density is defined as the total number of vehicles occupying a given length of a lane at a given time. Speed of the traffic stream will also be considered since it helps assess the service quality of the facility. Threshold values of density help determine level of service of the freeway and ramp facilities.

The level of service for signalized intersections is usually measured in terms of control delay values. The average control delay per vehicle in every lane group of the intersection approach is aggregated to obtain the overall control delay of the intersection. Control delay is expressed in seconds per vehicle (s/veh). The aggregation of control delay for every individual lane group at intersection approaches helps identify individual movements operating inefficiently, and consequently, hindering overall intersection operations. Threshold values of control delay per vehicle help determine level of service of the signalized intersections and its approaches.

The operation of multilane arterials is usually measured in terms of density, speed, and volume to capacity ratios. The level of service is usually defined in terms of density measured in vpmpl. Driver freedom to maneuver and change lanes is restricted at higher densities resulting in lower operating speeds. Forced flow or flow breakdown occurs when the vehicular demand or arrival rate exceeds that of the discharge rate. Volume to capacity (v/c) ratios greater than 1.0 indicates vehicular demand exceeding available capacity. The level of service for urban arterials is also influenced by the total number of signalized intersections per mile, signal timing, and signal coordination. Poor coordination can result in spillback affecting operations of downstream intersections. Threshold values of density and speed help determine levels of service of the freeway and ramp facilities.

The traffic operations of un-signalized intersections or roundabouts can be analyzed for individual approaches only and not for the whole intersection. Level of service is measured in terms of control delay expressed (s/veh). Threshold values of control delay values help determine level of service for the individual movements at unsignalized intersections or roundabouts. The capacity of a roundabout is however, dependent mainly on the gap acceptance behavior of the drivers with respect to critical gap and follow-up time parameters.

Table 4-8 shows the range of the Highway Capacity Manual (HCM) recommended threshold values for various roadway elements and their measures of effectiveness that can be used to determine level of service for the study area roadway network. The cumulative measures of effectiveness obtained from CORSIM output reports were compared against the threshold values to determine levels of service and operational conditions.

Table 4-8: HCM Recommended Threshold Values of Measures of Effectiveness for LOS Determination

LOS	Freeway Density Range (vpmpl)	Ramp Segment Density Range (vpmpl)	Intersection Control Delay per vehicle (s/veh)	Class III Urban Street (typical speed of 35 mph)	Roundabout Average Control Delay [1] (s/veh)
A	0-11	≤ 10	≤ 10	> 30	0-10
B	> 11-18	> 10-20	> 10-20	> 24-30	> 10-15
C	> 18-26	> 20-28	> 20-35	> 18-24	> 15-25
D	> 26-35	> 28-35	> 35-55	> 14-18	> 25-35
E	> 35-45	> 35	> 55-80	> 10-14	> 35-50
F	> 45	Note 2	> 80	<= 10	> 50

Note:

1. Data Source - 2010 Highway Capacity Manual (Pre-Release)
2. Demand exceeds capacity

4.4.5 Baseline Traffic Operations without Improvements

Traffic operational analysis of existing roadway network with 2011 baseline traffic volumes without any proposed BRAC 133 generated traffic was performed using CORSIM and Synchro analysis tools. The existing roadway geometry and lane configuration previously shown in Figure 4.3 and the baseline (2011) traffic volumes previously shown in Figure 4-4 were used as primary inputs to perform the existing condition traffic operational analysis for the morning and evening peak hour demands. Optimized signal timing and coordination plans were used in developing the 2011 baseline traffic models without BRAC improvements. Multiple simulation runs were made by changing the random seed values for vehicle entry headways, driver responses to traffic choices including gap acceptance, lane change and queue blockages, and driver and vehicle behavior assignment of to surface street vehicles. The data from the multiple runs was evaluated for the baseline condition morning and evening peak hour analysis. Flow rate, speed and density data for freeway mainline and ramp links, and flow rate, control delay, and maximum queue lengths by intersection approach movements for surface links were obtained from the simulation output reports to determine roadway traffic operations.

Table 4-9 and Table 4-10 show the 2011 baseline traffic operational analysis results for I-395 mainline and ramp sections including speed, density, and level of service. Table 4-11 and Table 4-12 show the 2011 baseline traffic operational analysis results of the arterial network including control delay, level of service and traffic queues by lane group movement, intersection approach, and overall intersection, for all the signalized intersections within the study area. In Tables 4-9 through 4-13, intersections with the highest levels of congestion (LOS E and LOS F) have been highlighted for ease of reference.

Results of the 2011 baseline operational analysis without BRAC improvements indicate most of the freeway network and overall signalized intersections operating at acceptable level of service, except for the Seminary Road and North Beauregard Street intersection that operates at a LOS E during the morning and evening peak hours, and the southeast rotary intersection that operates at a LOS E during the morning peak hour. However, as can be seen from Table 4-11 and Table 4-12, many of the lane group movements and intersection approaches operate at unacceptable level of service for the 2011 baseline condition. These degrading operations at the individual approaches will eventually lead to the failure of the overall intersection.

In addition to the above analysis, all the level of service results obtained from the prior traffic operational analysis and transportation studies conducted for the study area roadway network were summarized for comparison. Table 4-13 shows the comparative summary of level of service results from prior studies. In Tables 4-9 through 4-13, intersections with the highest levels of congestion (LOS E and LOS F) have been highlighted for ease of reference.

Table 4-9: Freeway Measures of Effectiveness for the Morning (AM) Peak Hour 2011 Baseline Traffic Operational Analysis without Improvements

		LOCATION		NODE		LENGTH (ft)	VOLUMES			LINK STATISTICS			AGGREGATE STATISTICS			REMARKS
		From	To	From	To		Projected Demand	Model Throughput	Model Throughput vs Projected Demand	Speed (mph)	Density (vpmpl)	LOS	Speed (mph)	Density (vpmpl)	LOS	
I-395 GENERAL PURPOSE (GP) & HIGH OCCUPANCY VEHICLE (HOV) LANES	I-395 NORTHBOUND MAINLINE	NB GP	Begin I-395 GP Lanes South of Seminary Road Interchange	1000	1001	692	6300	6296	-4	62	35	D				NB Freeway Mainline
				1001	1002	803	6300	6299	-1	61	34	D	**61**	**32**	**D**	NB Freeway Mainline
				1002	1005	1073	6300	6310	10	59	28	D				NB Freeway Mainline
		NB GP	Seminary Road Exit Ramp	1005	1006	790	5410	5415	5	61	29	D				NB Freeway Mainline
				1006	1008	1235	5410	5420	10	61	30	D	**61**	**30**	**D**	NB Freeway Mainline
				1008	1010	860	5410	5422	12	61	30	D				NB Freeway Mainline
		NB GP	Seminary Road Entrance Ramp	1010	1011	1093	6930	6720	-210	57	26	C	**57**	**27**	**D**	NB Freeway Mainline
				1011	1015	706	6930	6729	-201	57	29	D				NB Freeway Mainline
		NB GP	King Street Exit Ramp	1015	1017	635	5890	5691	-199	60	32	D	**60**	**31**	**D**	NB Freeway Mainline
		NB GP	End I-395 North of Seminary Road Interchange	1017	1019	485	5890	5691	-199	61	31	D				NB Freeway Mainline
		NB HOV	Begin I-395 HOV Lanes South of Seminary Road Interchange	1052	1053	643	3370	3353	-17	67	26	C				NB Freeway Mainline
				1053	1054	534	3370	3355	-15	68	25	C				NB Freeway Mainline
				1054	1056	501	3370	3357	-13	67	25	C				NB Freeway Mainline
				1056	1057	417	3370	3358	-12	66	25	C				NB Freeway Mainline
				1057	1058	513	3370	3361	-9	66	26	C	**66**	**26**	**C**	NB Freeway Mainline
				1058	1060	616	3370	3365	-5	65	26	C				NB Freeway Mainline
				1060	1062	560	3370	3370	0	65	26	C				NB Freeway Mainline
				1062	1063	525	3370	3373	3	65	26	C				NB Freeway Mainline
				1063	1064	571	3370	3370	0	65	26	C				NB Freeway Mainline
				1064	1066	675	3370	3370	0	65	26	C				NB Freeway Mainline
		NB HOV	Seminary Road HOV Entrance Ramp	1066	1067	1074	3490	3479	-11	64	20	C	**65**	**27**	**D**	NB Freeway Mainline
		NB HOV	End I-395 HOV Lanes North of Seminary Road Interchange	1067	1068	1010	3490	3481	-9	65	27	D				NB Freeway Mainline
	I-395 SOUTHBOUND MAINLINE	SB GP	Begin I-395 GP Lanes North of Seminary Road Interchange	2001	2002	812	3820	3822	2	64	15	B	**64**	**15**	**B**	SB Freeway Mainline
		SB GP	King Street Entrance Ramp	2002	2004	1209	4170	4180	10	60	14	B	**60**	**14**	**B**	SB Freeway Mainline
		SB GP	Seminary Road Exit Ramp	2004	2005	502	3450	3511	61	63	14	B				SB Freeway Mainline
				2005	2007	920	3450	3515	65	63	14	B	**63**	**14**	**B**	SB Freeway Mainline
				2007	2009	1142	3450	3512	62	63	14	B				SB Freeway Mainline
				2009	2012	1179	3450	3524	74	63	14	B				SB Freeway Mainline
		SB GP	Seminary Road Entrance Ramp	2012	2014	570	4210	4169	-41	56	17	B	**59**	**17**	**B**	SB Freeway Mainline
		SB GP	End I-395 South of Seminary Road Interchange	2014	2015	728	4210	4169	-41	61	17	B				SB Freeway Mainline
	I-395 NORTHBOUND RAMPS	NB GP	Seminary Road Exit Ramp	1005	1201	299	890	953	63	34	28	D	**34**	**28**	**D**	Diverge Ramp Section
				1201	7002	203	890	951	61	34	28	D				Diverge Ramp Section
				7002	1203	232	890	884	-6	43	-	A				Class III Type Urban Arterial
		NB GP	Seminary Road Entrance Ramp	1206	1208	232	1520	1299	-221	27	-	B				Class III Type Urban Arterial
				1208	7003	201	1520	1300	-220	33	-	A				Class III Type Urban Arterial
				7003	1210	221	1520	1312	-208	34	21	C	**34**	**20**	**C**	Merge Ramp Section
				1210	1010	234	1520	1315	-205	34	19	B				Merge Ramp Section
		NB HOV	Seminary Road Entrance Ramp	1212	1213	358	120	91	-29	27	-	B				Class III Type Urban Arterial
				1213	7005	331	120	91	-29	37	-	A				Class III Type Urban Arterial
				7005	1070	339	120	110	-10	45	3	A	**47**	**2**	**A**	Merge Ramp Section
				1070	1066	306	120	110	-10	49	2	A				Merge Ramp Section
	I-395 SOUTHBOUND RAMPS	SB GP	Seminary Road Exit Ramp	2004	2201	313	720	675	-45	35	10	A	**35**	**10**	**A**	Diverge Ramp Section
				2201	7004	485	720	676	-44	35	10	A				Diverge Ramp Section
				7004	2204	491	720	613	-107	39	-	A				Class III Type Urban Arterial
				2204	2205	376	720	616	-104	26	-	B				Class III Type Urban Arterial
		SB GP	Seminary Road Entrance Ramp	2213	2215	197	760	658	-102	32	-	A				Class III Type Urban Arterial
				2215	7001	371	760	659	-101	33	-	A				Class III Type Urban Arterial
				7001	2216	279	760	701	-59	32	12	B	**32**	**16**	**B**	Merge Ramp Section
				2216	2012	427	760	699	-61	32	19	B				Merge Ramp Section

Table 4-10: Freeway Measures of Effectiveness for the Evening (PM) Peak Hour 2011 Baseline Traffic Operational Analysis without Improvements

		LOCATION		NODE		LENGTH (ft)	VOLUMES			LINK STATISTICS			AGGREGATE STATISTICS			REMARKS
		From	To	From	To		Projected Demand	Model Throughput	Model Throughput vs Projected Demand	Speed (mph)	Density (vpmpl)	LOS	Speed (mph)	Density (vpmpl)	LOS	
I-395 GENERAL PURPOSE (GP) & HIGH OCCUPANCY VEHICLE (HOV) LANES	I-395 NORTHBOUND MAINLINE	NB GP	Begin I-395 GP Lanes South of Seminary Road Interchange	1000	1001	692	5510	5499	-11	62	30	D				NB Freeway Mainline
				1001	1002	803	5510	5496	-14	61	30	D	60	28	D	NB Freeway Mainline
				1002	1005	1073	5510	5486	-24	58	24	C				NB Freeway Mainline
		NB GP	Seminary Road Exit Ramp	1005	1006	790	4400	4309	-91	62	23	C				NB Freeway Mainline
				1006	1008	1235	4400	4293	-107	62	23	C	62	23	C	NB Freeway Mainline
				1008	1010	860	4400	4295	-105	62	23	C				NB Freeway Mainline
		NB GP	Seminary Road Entrance Ramp	1010	1011	1093	5335	5241	-94	58	20	C	58	21	C	NB Freeway Mainline
				1011	1015	706	5335	5240	-95	57	23	C				NB Freeway Mainline
		NB GP	King Street Exit Ramp	1015	1017	635	4055	3940	-115	62	21	C	62	21	C	NB Freeway Mainline
		NB GP	End I-395 North of Seminary Road Interchange	1017	1019	485	4055	3942	-113	62	21	C				NB Freeway Mainline
	I-395 SOUTHBOUND MAINLINE	SB GP	Begin I-395 GP Lanes North of Seminary Road Interchange	2001	2002	812	5940	5942	2	63	24	C	61	22	C	SB Freeway Mainline
		SB GP	King Street Entrance Ramp	2002	2004	1209	6430	6433	3	60	21	C				SB Freeway Mainline
		SB GP	Seminary Road Exit Ramp	2004	2005	502	5380	5517	137	62	22	C				SB Freeway Mainline
				2005	2007	920	5380	5527	147	62	22	C	62	22	C	SB Freeway Mainline
				2007	2009	1142	5380	5523	143	62	22	C				SB Freeway Mainline
				2009	2012	1179	5380	5515	135	61	23	C				SB Freeway Mainline
		SB GP	Seminary Road Entrance Ramp	2012	2014	570	6768	6728	-40	48	32	D	54	30	D	SB Freeway Mainline
		SB GP	End I-395 South of Seminary Road Interchange	2014	2015	728	6768	6718	-50	58	29	D				SB Freeway Mainline
		SB HOV	Begin I-395 HOV Lanes South of Seminary Road Interchange	1068	1067	1010	3290	3293	3	67	25	C	67	25	C	SB Freeway Mainline
				1067	1066	1066	3290	3299	9	66	25	C				SB Freeway Mainline
		SB HOV	Seminary Road Exit Ramp	1066	1064	685	3190	3171	-19	65	24	C				SB Freeway Mainline
				1064	1063	564	3190	3171	-19	66	24	C				SB Freeway Mainline
				1063	1062	582	3190	3167	-23	66	24	C				SB Freeway Mainline
				1062	1060	505	3190	3167	-23	66	24	C				SB Freeway Mainline
				1060	1058	616	3190	3170	-20	66	24	C				SB Freeway Mainline
				1058	1057	513	3190	3170	-20	65	24	C	82	27	D	SB Freeway Mainline
				1057	1056	417	3190	3172	-18	65	24	C				SB Freeway Mainline
				1056	1054	477	3190	3175	-15	65	24	C				SB Freeway Mainline
				1054	1053	456	3190	3181	-9	65	24	C				SB Freeway Mainline
		SB HOV	End I-395 HOV Lanes North of Seminary Road Interchange	1053	1052	654	3190	3182	-8	65	24	C				SB Freeway Mainline
	I-395 NORTHBOUND RAMPS	NB GP	Seminary Road Exit Ramp	1005	1201	299	1110	1123	13	33	34	D	33	34	D	Diverge Ramp Section
				1201	7002	203	1110	1123	13	33	34	D				Diverge Ramp Section
				7002	1203	232	1110	1123	13	43	-	A				Class III Type Urban Arterial
		NB GP	Seminary Road Entrance Ramp	1206	1208	232	935	927	-8	29	-	B				Class III Type Urban Arterial
				1208	7003	201	935	927	-8	32	-	A				Class III Type Urban Arterial
				7003	1210	221	935	927	-8	34	15	B	34	14	B	Merge Ramp Section
				1210	1010	234	935	927	-8	34	14	B				Merge Ramp Section
	I-395 SOUTHBOUND RAMPS	SB GP	Seminary Road Exit Ramp	2004	2201	313	1050	921	-129	35	13	B	35	13	B	Diverge Ramp Section
				2201	7004	485	1050	923	-127	35	13	B				Diverge Ramp Section
				7004	2204	491	1050	920	-130	38	-	A				Class III Type Urban Arterial
				2204	2205	376	1050	920	-130	28	-	B				Class III Type Urban Arterial
		SB GP	Seminary Road Entrance Ramp	2213	2215	197	1388	1226	-162	30	-	B				Class III Type Urban Arterial
				2215	7001	371	1388	1220	-168	32	-	A				Class III Type Urban Arterial
				7001	2216	279	1388	1217	-171	32	21	C	32	29	D	Merge Ramp Section
				2216	2012	427	1388	1211	-177	31	35	D				Merge Ramp Section
		SB HOV	Seminary Road Exit Ramp	1066	1070	317	100	125	25	49	3	A	49	3	A	Diverge Ramp Section
				1070	7005	352	100	125	25	50	3	A				Diverge Ramp Section
				7005	1213	340	100	125	25	56	-	A				Class III Type Urban Arterial
				1213	1212	329	100	126	26	34	-	A				Class III Type Urban Arterial
				1212	1211	130	100	126	26	16	-	C				Class IV Type Urban Arterial

Table 4-11: Arterial Measures of Effectiveness for the Morning (AM) Peak Hour 2011 Baseline Traffic Operational Analysis without Improvements

MARK CENTER (BRAC 133) TRAFFIC ANALAYSIS STUDY AREA

Area	Location	Approach	Link	Projected Demand				Model Throughput				Model Throughput vs Projected Demand				Control Delay By Movement			LOS By Movement			LOS By Approach		LOS By Intersection		Modelled Storage and Maximum Traffic Queuing (ft): Through		Left Turn		Right Turn	
				Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Left	Thru	Right	Delay	LOS	Delay	LOS	Link Length (ft)	Queue (ft)	Storage (ft)	Queue (ft)	Storage (ft)	Queue (ft)
LIBRARY LANE	Library Lane / Seminary Road (Node #5003)	WB	5002-5003	20	1301	91	1412	24	1308	76	1408	4	7	-15	-4	14	9	7	B	A	A	9	A	10	A	310	720	50	120	-	-
		NB	6017-5003	36	5	5	46	41	5	1	47	5	0	-4	1	29	27	3	C	C	A	28	C			264	100	-	-	-	-
		EB	5005-5003	212	798	11	1021	235	823	9	1067	23	25	-2	46	22	5	11	C	A	B	9	A			311	160	150	140	-	-
		SB	6018-5003	41	5	15	61	43	4	13	60	2	-1	-2	-1	32	39	17	C	D	B	29	C			216	120	-	-	-	-
I-395 / SEMINARY ROAD ROTARY INTERCHANGE	I-395 NB Off-Ramp/Seminary Road (Node #5015)	NB	1203-5015	0	692	198	890	0	733	215	948	0	41	17	58	0	33	45	-	C	D	35	D	56	E	618	460	-	-	-	-
		EB	5013-5015	758	301	0	1059	694	290	0	984	-64	-11	0	-75	79	63	0	E	E	-	74	E			331	300	331	280	-	-
	I-395 NB On-Ramp/Seminary Road (Node #5010)	NB	5015-5010	559	60	831	1450	564	59	801	1424	5	-1	-30	-26	7	17	21	A	B	C	15	B	23	C	276	240	75	200	-	-
		WB	5009-5010	0	327	60	387	0	278	51	329	0	-49	-9	-58	0	53	42	-	D	D	51	D			160	140	-	-	-	-
	I-395 SB Off-Ramp/Seminary Road (Node #5012)	WB	5010-5012	267	619	0	886	273	567	0	840	6	-52	0	-46	4	4	0	A	A	-	4	A	16	B	300	140	300	180	-	-
		SB	2205-5012	0	233	0	233	0	213	0	213	0	-20	0	-20	0	59	0	-	E	A	59	E			281	140	-	-	-	-
	I-395 SB On-Ramp/Seminary Road (Node #5013)	SB	5012-5013	214	286	0	500	215	269	0	484	1	-17	0	-16	59	19	0	E	B	-	36	D	52	D	259	120	259	160	-	-
		WB	5019-5013	0	845	0	845	0	786	0	786	0	-59	0	-59	0	60	0	-	E	-	60	E			357	340	-	-	-	-
MARK CENTER DRIVE	Mark Center Drive / Seminary Road (Node #5022)	WB 1	5021-5022	181	729	35	945	154	525	19	698	-27	-204	-16	-247	76	7	3	E	A	A	22	C	23	C	243	160	243	220	-	-
		WB 2	5018-5022	0	1050	56	1106	0	980	49	1029	0	-70	-7	-77	0	14	14	-	B	B	14	B			637	440	-	-	-	-
		NB	5060-5022	10	11	131	152	15	9	134	158	5	-2	3	6	82	63	10	F	E	A	20	B			340	60	340	60	340	60
		EB	5023-5022	20	1348	67	1435	33	1322	41	1396	13	-26	-26	-39	55	15	0	D	B	A	15	B			395	300	150	80	395	160
		SB	5045-5022	232	50	50	332	235	47	46	328	3	-3	-4	-4	93	88	10	F	F	A	80	F			252	240	252	200	252	40
N. BEAUREGARD STREET	N. Beauregard Street / Seminary Road (Node #5025)	WB	5023-5025	545	1112	0	1657	464	968	0	1432	-81	-144	0	-225	55	14	0	D	B	-	28	C	63	E	341	280	341	340	-	-
		NB	6004-5025	455	545	0	1000	369	454	0	823	-86	-91	0	-177	289	56	0	F	E	-	161	F			347	380	175	160	-	-
		EB	5026-5025	61	991	0	1052	56	988	0	1044	-5	-3	0	-8	79	35	0	E	C	-	37	D			323	300	100	100	-	-
		SB	6002-5025	91	157	40	288	90	158	39	287	-1	1	-1	-1	75	41	27	E	D	C	50	D			250	120	135	120	-	-
	N. Beauregard Street / Mark Center Drive (Node #6005)	WB	5032-6005	15	5	15	35	26	12	26	64	11	7	11	29	86	80	10	F	E	B	54	D	51	D	286	40	-	-	286	60
		NB	6007-6005	51	1328	182	1561	38	1172	151	1361	-13	-156	-31	-200	117	57	86	F	E	F	62	E			329	320	150	100	-	-
		EB	5030-6005	10	5	6	21	13	6	2	21	3	1	-4	0	84	39	2	F	D	A	63	E			203	100	-	-	-	-
		SB	6004-6005	359	425	81	865	351	359	75	785	-8	-66	-6	-80	60	4	2	E	A	A	29	C			435	420	350	380	-	-

Table 4-12: Arterial Measures of Effectiveness for the Evening (PM) Peak Hour 2011 Baseline Traffic Operational Analysis without Improvements

MARK CENTER (BRAC 133) TRAFFIC ANALAYSIS STUDY AREA

Corridor	Location	Approach	Link	Projected Demand				Model Throughput				Model Throughput vs Projected Demand				Control Delay By Movement			LOS By Movement			LOS By Approach		LOS By Intersection		Modelled Storage and Maximum Traffic Queuing (ft): Through		Left Turn		Right Turn	
				Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Left	Thru	Right	Delay	LOS	Delay	LOS	Link Length (ft)	Queue (ft)	Storage (ft)	Queue (ft)	Storage (ft)	Queue (ft)
LIBRARY LANE	Library Lane / Seminary Road (Node #5003)	WB	5002-5003	25	808	40	873	23	819	37	879	-2	11	-3	6	21	9	5	C	A	A	9	A	10	A	310	160	50	40	-	-
		NB	6017-5003	52	5	10	67	53	5	6	64	1	0	-4	-3	34	27	31	C	C	C	33	C			264	80	-	-	-	-
		EB	5005-5003	223	1192	21	1436	245	1217	13	1475	22	25	-8	39	11	6	4	B	A	A	7	A			311	160	150	120	-	-
		SB	6018-5003	86	15	30	131	91	16	23	130	5	1	-7	-1	38	44	23	D	D	C	36	D			216	200	-	-	-	-
I-395 / SEMINARY ROAD ROTARY INTERCHANGE	I-395 NB Off-Ramp/Seminary Road (Node #5015)	NB	1203-5015	0	735	375	1110	0	721	399	1120	0	-14	24	10	0	17	19	A	B	B	18	B	21	C	618	300	-	-	-	-
		EB	5013-5015	485	913	0	1398	487	855	0	1342	2	-58	0	-56	23	23	0	C	C	A	23	C			331	260	331	200	-	-
	I-395 NB On-Ramp/Seminary Road (Node #5010)	NB	5015-5010	569	651	0	1220	538	667	0	1205	-31	16	0	-15	9	7	0	A	A	A	8	A	10	A	276	120	276	200	-	-
		WB	5009-5010	0	309	0	309	0	319	0	319	0	10	0	10	0	15	0	A	B	A	15	B			160	120	-	-	-	-
	I-395 SB Off-Ramp/Seminary Road (Node #5012)	WB	1211-5012	304	674	0	978	308	643	0	951	4	-31	0	-27	10	9	0	A	A	A	10	A	12	B	300	100	300	100	-	-
		SB	2205-5012	0	632	0	632	0	539	0	539	0	-93	0	-93	0	16	0	A	B	A	16	B			281	180	-	-	-	-
	I-395 SB On-Ramp/Seminary Road (Node #5013)	SB	5012-5013	630	306	0	936	583	260	0	843	-47	-46	0	-93	10	9	0	A	A	A	9	A	10	A	259	140	259	120	-	-
		WB	5019-5013	0	768	0	768	0	750	0	750	0	-18	0	-18	0	11	0	A	B	A	11	B			357	140	-	-	-	-
MARK CENTER DRIVE	Mark Center Drive / Seminary Road (Node #5022)	WB 1	5021-5022	71	536	39	646	63	573	35	671	-8	37	-4	25	70	13	10	E	B	A	18	B	21	C	243	160	243	120	-	-
		WB 2	5018-5022	0	1030	62	1092	0	970	45	1015	0	-60	-17	-77	0	24	20	A	C	B	24	C			637	580	-	-	-	-
		NB	5060-5022	81	52	506	639	65	38	398	501	-16	-14	-108	-138	71	75	15	E	E	B	27	C			340	160	340	160	340	140
		EB	5023-5022	35	1680	28	1743	52	1668	23	1743	17	-12	-5	0	66	11	4	E	B	A	13	B			395	220	150	80	395	120
		SB	5045-5022	187	10	71	268	192	9	68	269	5	-1	-3	1	66	80	17	E	E	B	54	D			252	200	252	100	252	80
N. BEAUREGARD STREET	N. Beauregard Street / Seminary Road (Node #5025)	WB	5023-5025	485	1031	0	1516	505	991	0	1496	20	-40	0	-20	82	18	0	F	B	A	39	D	61	E	341	280	341	200	-	-
		NB	6004-5025	364	404	0	768	371	390	0	761	7	-14	0	-7	199	57	0	F	E	A	126	F			347	380	175	160	-	-
		EB	5026-5025	106	1192	0	1298	99	1212	0	1311	-7	20	0	13	136	31	0	F	C	A	39	D			323	300	100	100	-	-
		SB	6002-5025	147	430	46	623	153	429	48	630	6	-1	2	7	167	49	52	F	D	D	78	E			250	240	135	160	-	-
	N. Beauregard Street / Mark Center Drive (Node #6005)	WB	5032-6005	116	5	90	211	114	7	89	210	-2	2	-1	-1	62	89	5	E	F	A	39	D	23	C	286	260	-	-	286	60
		NB	6007-6005	45	1010	20	1075	45	1018	12	1075	0	8	-8	0	70	9	3	E	A	A	12	B			329	280	150	80	-	-
		EB	5030-6005	72	20	31	123	78	18	19	115	6	-2	-12	-8	62	66	47	E	E	D	60	E			203	200	-	-	-	-
		SB	6004-6005	76	1350	15	1441	89	1328	21	1438	13	-22	6	-3	59	23	36	E	C	D	25	C			435	460	350	80	-	-

Table 4-13: LOS Analyses of Previous Studies (Existing Conditions without BRAC 133)

Intersection	Intersection Approach	Wells & Associates Original TIS/TMP for NCPC, 2003 (Analysis Year 2002-2003)				Wells & Associates TIMP 2008 (Analysis Year 2008)				VHB Mark Center (BRAC 133) Study, City of Alexandria, 2009 (Analysis Year 2008)				PB Mark Center (BRAC 133) Study VDOT (Analysis Year 2008)				Mark Center (BRAC 133) IJR VDOT, 2010 (Analysis Year 2008)				Mark Center (BRAC 133) TMP USACE, 2010 (Analysis Year 2011)			
		By Approach		By Intersection		By Approach		By Intersection		By Approach		By Intersection		By Approach		By Intersection		By Approach		By Intersection		By Approach		By Intersection	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Seminary Rd. / Library Ln.	Eastbound									A	A	A	B					A	A	B	B	A	A	A	A
	Westbound									A	B							B	B			A	A		
	Northbound									E	D							D	D			C	C		
	Southbound									D	E							D	D			C	D		
I-395 NB Off-Ramp / Seminary Rd. (Southeast Rotary Intersection)	Eastbound	C	C	B	C	B	C	B	C	A	A	F	F	A	A	D	E	A	B	F	F	E	C	E	C
	Westbound	-	-			-	-			-	-			-	-			-	-			-	-		
	Northbound	C	C			B	B			F	F			F	F			F	F			D	B		
	Southbound	-	-			-	-			-	-			-	-			-	-			-	-		
I-395 NB On-Ramp / Seminary Rd. (Northeast Rotary Intersection)	Eastbound	-	-	C	C	-	-	B	B	-	-	B	B	-	-	B	B	-	-	B	B	-	-	C	A
	Westbound	C	C			C	C			C	D			C	D			C	D			D	B		
	Northbound	B	C			B	B			A	A			A	A			A	A			B	A		
	Southbound	-	-			-	-			-	-			-	-			-	-			-	-		
I-395 SB Off-Ramp / Seminary Rd. (Northwest Rotary Intersection)	Eastbound	-	-	B	C	-	-	B	C	-	-	B	C	-	-	B	C	-	-	B	C	-	-	B	B
	Westbound	C	B			C	C			A	A			A	A			A	A			A	A		
	Northbound	-	-			-	-			-	-			-	-			-	-			-	-		
	Southbound	B	C			B	C			C	D			C	D			C	E			E	B		
I-395 SB On-Ramp / Seminary Rd. (Southwest Rotary Intersection)	Eastbound	B	B	B	B	B	C	B	B	D	C	C	C	E	C	C	B	D	C	C	C	E	B	D	A
	Westbound	-	-			-	-			-	-			-	-			-	-			-	-		
	Northbound	-	-			-	-			-	-			-	-			-	-			-	-		
	Southbound	B	D			C	B			A	A			A	A			B	B			D	A		
Seminary Rd. / Mark Center Dr.	Eastbound	C	F	C	D	A	C	C	C	B	B	C	C	A	B	B	C	A	B	D	C	B	B	C	C
	Westbound	D	D			D	B			C	C			B	C			D	C			C	C		
	Northbound	C	B			A	A			C	D			B	D			C	D			B	C		
	Southbound	B	D			D	D			D	D			D	D			D	D			F	D		
Seminary Rd. / N. Beauregard St.	Eastbound	D	D	C	D	C	C	C	D	D	D	D	D	D	E	D	E	D	C	D	D	D	D	E	E
	Westbound	D	F			C	D			C	C			D	D			E	C			C	D		
	Northbound	C	D			C	D			E	F			D	E			C	D			F	F		
	Southbound	C	C			C	D			D	E			D	E			D	D			D	E		
N. Beauregard St. / Mark Center Dr.	Eastbound	B	A	B	B	D	C	B	B	D	D	A	B	D	D	C	B	D	D	B	B	E	E	D	C
	Westbound	B	B			C	B			D	E			D	E			D	D			D	C		
	Northbound	D	D			A	A			A	A			B	B			A	A			E	B		
	Southbound	D	D			B	B			A	A			C	A			B	A			C	C		

4.4.6 Projected Roadway Traffic Operations

Traffic operational analysis for the proposed condition with projected BRAC 133 trips and interim roadway improvements was performed using CORSIM and Synchro analysis tools. The existing roadway geometry and lane configuration along with interim improvements as shown previously in Figure 4-3, and the projected build-out condition traffic volumes on opening day (2011), including baseline trips, BRAC 133 and IDA generated SOV, rideshare and shuttle trips as shown previously in Figure 4-6 were used as primary inputs to perform the proposed condition traffic operational analysis for the morning and evening peak hour demands.

Optimized signal timing and coordination plans developed using Synchro were transferred appropriately to CORSIM to develop overall study area traffic models. As noted in Section 4.2.2, delineation of the existing island within the rotary and restriping would improve the rotary capacity. Traffic simulation models for the 2011 projected condition utilized this modified configuration to allow three full lanes to circulate the rotary. Multiple simulation runs were made by changing the random seed values for vehicle entry headways, driver responses to traffic choices including gap acceptance, lane change and queue blockages, and driver and vehicle behavior assignment of to surface street vehicles. The data from the multiple runs was evaluated for the projected condition morning and evening peak hour analysis.

Flow rate, speed and density data for freeway mainline and ramp links, and flow rate, control delay, and maximum queue lengths by intersection approach movements for surface links were obtained from the simulation output reports to determine traffic operations. Table 4-14 and Table 4-15 show the traffic operational parameters for the I-395 mainline and ramps under the 2011 projected conditions, including speed, density, and level of service.

Table 4-16 and Table 4-17 show the 2011 projected condition traffic operations of the arterial network including control delay, level of service, and traffic queues by movement, intersection approach and overall intersection for all the signalized intersections within the study area. In Tables 4-14 through 4-17, intersections with the highest levels of congestion (LOS E and LOS F) have been highlighted for ease of reference.

Table 4-14: Freeway Measures of Effectiveness for the AM Peak Hour 2011 Projected Traffic Operational Analysis with Interim Improvements

		LOCATION		NODE		LENGTH (ft)	VOLUMES			LINK STATISTICS			AGGREGATE STATISTICS			REMARKS
		From	To	From	To		Projected Demand	Model Throughput	Model Throughput vs Projected Demand	Speed (mph)	Density (vpmpl)	LOS	Speed (mph)	Density (vpmpl)	LOS	
I-395 GENERAL PURPOSE (GP) & HIGH OCCUPANCY VEHICLE (HOV) LANES	I-395 NORTHBOUND MAINLINE	NB GP	Begin I-395 GP Lanes South of Seminary Road Interchange	1000	1001	692	6828	6343	-485	37	58	F				NB Freeway Mainline
				1001	1002	803	6828	6346	-482	61	93	F	41	69	F	NB Freeway Mainline
				1002	1005	1073	6828	6264	-564	28	57	F				NB Freeway Mainline
		NB GP	Seminary Road Exit Ramp	1005	1006	790	5410	5002	-408	59	28	D				NB Freeway Mainline
				1006	1008	1235	5410	5007	-403	61	28	D	60	28	D	NB Freeway Mainline
				1008	1010	860	5410	5018	-392	61	27	D				NB Freeway Mainline
		NB GP	Seminary Road Entrance Ramp	1010	1011	1093	6976	6340	-636	57	24	C	58	25	C	NB Freeway Mainline
				1011	1015	706	6976	6344	-632	58	27	D				NB Freeway Mainline
		NB GP	King Street Exit Ramp	1015	1017	635	5936	5343	-593	61	29	D	61	29	D	NB Freeway Mainline
		NB GP	End I-395 North of Seminary Road Interchange	1017	1019	485	5936	5349	-587	61	29	D				NB Freeway Mainline
		NB HOV	Begin I-395 HOV Lanes South of Seminary Road Interchange	1052	1053	643	3370	3377	7	67	26	C				NB Freeway Mainline
				1053	1054	534	3370	3374	4	68	25	C				NB Freeway Mainline
				1054	1056	501	3370	3369	-1	67	25	C				NB Freeway Mainline
				1056	1057	417	3370	3364	-6	67	25	C				NB Freeway Mainline
				1057	1058	513	3370	3362	-8	66	26	C	66	26	C	NB Freeway Mainline
				1058	1060	616	3370	3359	-11	66	26	C				NB Freeway Mainline
				1060	1062	560	3370	3360	-10	66	26	C				NB Freeway Mainline
				1062	1063	525	3370	3361	-9	66	26	C				NB Freeway Mainline
				1063	1064	571	3370	3356	-14	65	26	C				NB Freeway Mainline
				1064	1066	675	3370	3356	-14	65	26	C				NB Freeway Mainline
		NB HOV	Seminary Road HOV Entrance Ramp	1066	1067	1074	3490	3484	-6	64	20	C				NB Freeway Mainline
		NB HOV	End I-395 HOV Lanes North of Seminary Road Interchange	1067	1068	1010	3490	3479	-11	65	27	D	65	27	D	NB Freeway Mainline
	I-395 SOUTHBOUND MAINLINE	SB GP	Begin I-395 GP Lanes North of Seminary Road Interchange	2001	2002	812	4188	3926	-262	18	57	F	18	57	F	SB Freeway Mainline
		SB GP	King Street Entrance Ramp	2002	2004	1209	4538	4033	-505	14	57	F	14	57	F	SB Freeway Mainline
		SB GP	Seminary Road Exit Ramp	2004	2005	502	3450	3359	-91	61	14	B				SB Freeway Mainline
				2005	2007	920	3450	3360	-90	63	13	B	62	13	B	SB Freeway Mainline
				2007	2009	1142	3450	3358	-92	63	13	B				SB Freeway Mainline
				2009	2012	1179	3450	3359	-91	63	13	B				SB Freeway Mainline
		SB GP	Seminary Road Entrance Ramp	2012	2014	570	4249	4062	-187	57	16	B	60	16	B	SB Freeway Mainline
		SB GP	End I-395 South of Seminary Road Interchange	2014	2015	728	4249	4064	-185	62	16	B				SB Freeway Mainline
	I-395 NORTHBOUND RAMPS	NB GP	Seminary Road Exit Ramp	1005	1201	299	1418	1246	-172	11	113	F	9	139	F	Diverge Ramp Section
				1201	7002	203	1418	1130	-288	6	176	F				Diverge Ramp Section
				7002	1203	232	1418	1189	-229	10	-	F				Class III Type Urban Arterial
		NB GP	Seminary Road Entrance Ramp	1206	1208	232	1566	1283	-283	28	-	B				Class III Type Urban Arterial
				1208	7003	201	1566	1281	-285	33	-	A				Class III Type Urban Arterial
				7003	1210	221	1566	1312	-254	34	21	C	34	20	C	Merge Ramp Section
				1210	1010	234	1566	1314	-252	34	19	B				Merge Ramp Section
		NB HOV	Seminary Road Entrance Ramp	1212	1213	358	120	111	-9	27	-	B				Class III Type Urban Arterial
				1213	7005	331	120	111	-9	37	-	A				Class III Type Urban Arterial
				7005	1070	339	120	133	13	46	3	A	48	3	A	Merge Ramp Section
				1070	1066	306	120	132	12	50	3	A				Merge Ramp Section
	I-395 SOUTHBOUND RAMPS	SB GP	Seminary Road Exit Ramp	2004	2201	313	1088	661	-427	3	124	F	2	158	F	Diverge Ramp Section
				2201	7004	485	1088	624	-464	2	179	F				Diverge Ramp Section
				7004	2204	491	1088	564	-524	1	-	F				Class III Type Urban Arterial
				2204	2205	376	1088	572	-516	1	-	F				Class III Type Urban Arterial
		SB GP	Seminary Road Entrance Ramp	2213	2215	197	799	693	-106	32	-	A				Class III Type Urban Arterial
				2215	7001	371	799	695	-104	33	-	A				Class III Type Urban Arterial
				7001	2216	279	799	708	-91	33	12	B	33	16	B	Merge Ramp Section
				2216	2012	427	799	707	-92	33	19	B				Merge Ramp Section

Table 4-15: Freeway Measures of Effectiveness for the PM Peak Hour 2011 Projected Traffic Operational Analysis with Interim Improvements

		LOCATION		NODE		LENGTH (ft)	VOLUMES			LINK STATISTICS			AGGREGATE STATISTICS			REMARKS
		From	To	From	To		Projected Demand	Model Throughput	Model Throughput vs Projected Demand	Speed (mph)	Density (vpmpl)	LOS	Speed (mph)	Density (vpmpl)	LOS	
I-395 GENERAL PURPOSE (GP) & HIGH OCCUPANCY VEHICLE (HOV) LANES	I-395 NORTHBOUND MAINLINE	NB GP	Begin I-395 GP Lanes South of Seminary Road Interchange	1000	1001	692	5574	5585	11	62	31	D	60	28	D	NB Freeway Mainline
				1001	1002	803	5574	5587	13	61	30	D				NB Freeway Mainline
				1002	1005	1073	5574	5588	14	58	25	C				NB Freeway Mainline
		NB GP	Seminary Road Exit Ramp	1005	1006	790	4400	4447	47	62	24	C	62	24	C	NB Freeway Mainline
				1006	1008	1235	4400	4445	45	62	24	C				NB Freeway Mainline
				1008	1010	860	4400	4445	45	61	24	C				NB Freeway Mainline
		NB GP	Seminary Road Entrance Ramp	1010	1011	1093	5660	5670	10	57	22	C	57	23	C	NB Freeway Mainline
				1011	1015	706	5660	5671	11	56	25	C				NB Freeway Mainline
		NB GP	King Street Exit Ramp	1015	1017	635	4380	4373	-7	61	24	C	62	24	C	NB Freeway Mainline
		NB GP	End I-395 North of Seminary Road Interchange	1017	1019	485	4380	4376	-4	62	24	C				NB Freeway Mainline
	I-395 SOUTHBOUND MAINLINE	SB GP	Begin I-395 GP Lanes North of Seminary Road Interchange	2001	2002	812	5996	5993	-3	63	24	C	61	23	C	SB Freeway Mainline
		SB GP	King Street Entrance Ramp	2002	2004	1209	6486	6490	4	59	22	C				SB Freeway Mainline
		SB GP	Seminary Road Exit Ramp	2004	2005	502	5380	5504	124	62	22	C	62	22	C	SB Freeway Mainline
				2005	2007	920	5380	5509	129	62	22	C				SB Freeway Mainline
				2007	2009	1142	5380	5511	131	62	22	C				SB Freeway Mainline
				2009	2012	1179	5380	5507	127	61	23	C				SB Freeway Mainline
		SB GP	Seminary Road Entrance Ramp	2012	2014	570	7239	6927	-312	47	34	D	53	32	D	SB Freeway Mainline
		SB GP	End I-395 South of Seminary Road Interchange	2014	2015	728	7239	6933	-306	58	30	D				SB Freeway Mainline
		SB HOV	Begin I-395 HOV Lanes South of Seminary Road Interchange	1068	1067	1010	3290	3290	0	67	25	C	67	25	C	SB Freeway Mainline
				1067	1066	1066	3290	3289	-1	67	25	C				SB Freeway Mainline
		SB HOV	Seminary Road Exit Ramp	1066	1064	685	3190	3190	0	66	24	C	82	28	D	SB Freeway Mainline
				1064	1063	564	3190	3196	6	66	24	C				SB Freeway Mainline
				1063	1062	582	3190	3193	3	66	24	C				SB Freeway Mainline
				1062	1060	505	3190	3188	-2	66	24	C				SB Freeway Mainline
				1060	1058	616	3190	3191	1	66	24	C				SB Freeway Mainline
				1058	1057	513	3190	3190	0	66	24	C				SB Freeway Mainline
				1057	1056	417	3190	3189	-1	65	24	C				SB Freeway Mainline
				1056	1054	477	3190	3193	3	65	24	C				SB Freeway Mainline
				1054	1053	456	3190	3196	6	65	25	C				SB Freeway Mainline
		SB HOV	End I-395 HOV Lanes North of Seminary Road Interchange	1053	1052	654	3190	3201	11	65	25	C				SB Freeway Mainline
	I-395 NORTHBOUND RAMPS	NB GP	Seminary Road Exit Ramp	1005	1201	299	1174	1145	-29	33	35	D	33	35	D	Diverge Ramp Section
				1201	7002	203	1174	1146	-28	33	35	D				Diverge Ramp Section
				7002	1203	232	1174	1147	-27	43	-	A				Class III Type Urban Arterial
		NB GP	Seminary Road Entrance Ramp	1206	1208	232	1260	1224	-36	29	-	B	34	19	C	Class III Type Urban Arterial
				1208	7003	201	1260	1228	-32	32	-	A				Class III Type Urban Arterial
				7003	1210	221	1260	1229	-31	34	20	B				Merge Ramp Section
				1210	1010	234	1260	1228	-32	34	18	B				Merge Ramp Section
	I-395 SOUTHBOUND RAMPS	SB GP	Seminary Road Exit Ramp	2004	2201	313	1106	983	-123	34	15	B	24	23	C	Diverge Ramp Section
				2201	7004	485	1106	960	-146	18	28	C				Diverge Ramp Section
				7004	2204	491	1106	925	-181	38	-	A				Class III Type Urban Arterial
				2204	2205	376	1106	882	-224	13	-	E				Class III Type Urban Arterial
		SB GP	Seminary Road Entrance Ramp	2213	2215	197	1859	1420	-439	32	-	A	34	34	D	Class III Type Urban Arterial
				2215	7001	371	1859	1419	-440	32	-	A				Class III Type Urban Arterial
				7001	2216	279	1859	1419	-440	38	24	C				Merge Ramp Section
				2216	2012	427	1859	1420	-439	32	40	E				Merge Ramp Section
		SB HOV	Seminary Road Exit Ramp	1066	1070	317	100	97	-3	49	2	A	49	2	A	Diverge Ramp Section
				1070	7005	352	100	98	-2	49	2	A				Diverge Ramp Section
				7005	1213	340	100	98	-2	56	-	A				Class III Type Urban Arterial
				1213	1212	329	100	99	-1	56	-	A				Class III Type Urban Arterial
				1212	1211	130	100	99	-1	20	-	C				Class III Type Urban Arterial

Table 4-16: Arterial Measures of Effectiveness for the AM Peak Hour 2011 Projected Traffic Operational Analysis with Interim Improvements

		Location	Approach	Link	Projected Demand				Model Throughput				Model Throughput vs Projected Demand				Control Delay By Movement			LOS By Movement			LOS By Approach		LOS By Intersection		Modelled Storage and Maximum Traffic Queuing (ft): Through		Left Turn		Right Turn	
					Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Left	Thru	Right	Delay	LOS	Delay	LOS	Link Length (ft)	Queue (ft)	Storage (ft)	Queue (ft)	Storage (ft)	Queue (ft)
MARK CENTER (BRAC 133) TRAFFIC ANALAYSIS STUDY AREA	LIBRARY LANE	Library Lane / Seminary Road (Node #5003)	WB	5002-5003	20	1580	91	1691	32	1584	74	1690	12	4	-17	-1	16	12	10	B	B	A	12	B	12	B	310	300	50	40	-	-
			NB	6017-5003	36	5	5	46	43	3	1	47	7	-2	-4	1	34	32	36	C	C	D	34	C			264	60	-	-	-	-
			EB	5005-5003	212	821	11	1044	214	792	9	1015	2	-29	-2	-29	21	6	8	C	A	A	9	A			311	180	150	120	-	
			SB	6018-5003	41	5	15	61	42	5	12	59	1	0	-3	-2	30	29	13	C	C	B	26	C			216	80	-	-	-	-
	I-395 / SEMINARY ROAD ROTARY INTERCHANGE	I-395 NB Off-Ramp/Seminary Road (Node #5015)	NB	1203-5015	0	1220	198	1418	0	950	163	1113	0	-270	-35	-305	0	71	99	-	E	F	75	E	79	E	618	560	-	-	-	-
			EB	5013-5015	804	301	0	1105	779	261	0	1040	-25	-40	0	-65	86	70	0	F	E	-	82	F			331	300	331	300	-	
		I-395 NB On-Ramp/Seminary Road (Node #5010)	NB	5015-5010	1087	60	877	2024	887	78	765	1730	-200	18	-112	-294	5	22	28	A	C	C	16	B	22	C	276	240	276	140	-	
			WB	5009-5010	0	327	60	387	0	295	55	350	0	-32	-5	-37	0	53	32	-	D	C	50	D			160	140	-	-	-	-
		I-395 SB Off-Ramp/Seminary Road (Node #5012)	WB	5010-5012	267	1147	0	1414	223	951	0	1174	-44	-196	0	-240	5	6	0	A	A	-	6	A	15	B	300	200	300	100	-	-
			SB	2205-5012	0	233	0	233	0	222	0	222	0	-11	0	-11	0	58	0	-	E	A	58	E			281	160	-	-	-	-
		I-395 SB On-Ramp/Seminary Road (Node #5013)	SB	5012-5013	214	286	0	500	201	246	0	447	-13	-40	0	-53	41	19	0	D	B	-	29	C	48	D	259	160	259	200	-	-
			WB	5019-5013	0	891	0	891	0	841	0	841	0	-50	0	-50	0	58	0	-	E	-	58	E			357	340	-	-	-	-
	MARK CENTER DRIVE	Mark Center Drive / Seminary Road (Node #5022)	WB 1	5021-5022	460	729	35	1224	304	611	22	937	-156	-118	-13	-287	195	40	49	F	D	D	91	F	51	D	243	280	243	260	-	-
			WB 2	5018-5022	0	1946	56	2002	0	1314	20	1334	0	-632	-36	-668	0	21	17	-	C	B	21	C			637	580	-	-	-	-
			NB	5060-5022	47	11	171	229	55	9	151	215	8	-2	-20	-14	94	105	9	F	F	A	35	C			340	80	340	120	340	60
			EB	5023-5022	20	1416	345	1781	35	1389	318	1742	15	-27	-27	-39	55	35	7	E	D	A	31	C			395	360	150	100	395	240
			SB	5045-5022	232	50	50	332	246	54	38	338	14	4	-12	6	180	224	20	F	F	C	169	F			252	280	252	240	252	140
	N BEAUREGARD STREET	N. Beauregard Street / Seminary Road (Node #5025)	WB	5023-5025	1441	1143	0	2584	1070	853	0	1923	-371	-290	0	-661	56	10	0	E	B	-	36	D	68	E	341	240	341	360	-	-
			NB	6004-5025	456	549	0	1005	354	471	0	825	-102	-78	0	-180	278	61	0	F	E	-	154	F			347	380	175	160	-	-
			EB	5026-5025	61	1183	0	1244	47	1200	0	1247	-14	17	0	3	100	49	0	F	D	-	51	D			323	300	100	100	-	-
			SB	6002-5025	177	218	40	435	169	222	43	434	-8	4	3	-1	155	43	32	F	D	C	86	F			250	260	135	140	-	-
		N. Beauregard Street / Mark Center Drive (Node #6005)	WB	5032-6005	36	5	88	129	71	19	164	254	35	14	76	125	62	74	15	E	E	B	32	C	47	D	286	140	-	-	286	160
			NB	6007-6005	51	1328	474	1853	32	1055	338	1425	-19	-273	-136	-428	123	67	26	F	E	C	58	E			329	360	150	100	-	-
			EB	5030-6005	10	5	6	21	9	7	4	20	-1	2	-2	-1	73	42	10	E	D	B	50	D			203	60	-	-	-	-
			SB	6004-6005	1361	425	81	1867	1074	375	67	1516	-287	-50	-14	-351	51	4	3	D	A	A	38	D			435	460	350	320	-	-

Table 4-17: Arterial Measures of Effectiveness for the PM Peak Hour 2011 Projected Traffic Operational Analysis with Interim Improvements

	Location	Approach	Link	Projected Demand				Model Throughput				Model Throughput vs Projected Demand				Control Delay By Movement			LOS By Movement			LOS By Approach		LOS By Intersection		Modelled Storage and Maximum Traffic Queuing (ft)					
																										Through		Left Turn		Right Turn	
				Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Left	Thru	Right	Delay	LOS	Delay	LOS	Link Length (ft)	Queue (ft)	Storage (ft)	Queue (ft)	Storage (ft)	Queue (ft)
MARK CENTER (BRAC 133) TRAFFIC ANALAYSIS STUDY AREA – LIBRARY LANE	Library Lane / Seminary Road (Node #5003)	WB	5002-5003	25	843	40	908	22	865	28	915	-3	22	-12	7	26	7	6	C	A	A	8	A	10	A	310	140	50	20	-	-
		NB	6017-5003	52	5	10	67	55	4	8	67	3	-1	-2	0	40	40	14	D	D	B	37	D			264	100	-	-	-	-
		EB	5005-5003	223	1441	21	1685	201	1286	11	1498	-22	-155	-10	-187	10	6	4	A	A	A	7	A			311	160	150	120	-	-
		SB	6018-5003	86	15	30	131	94	18	21	133	8	3	-9	2	39	38	21	D	D	C	36	D			216	160	-	-	-	-
I-395 / SEMINARY ROAD ROTARY INTERCHANGE	I-395 NB Off-Ramp/Seminary Road (Node #5015)	NB	1203-5015	0	799	375	1174	0	789	404	1193	0	-10	29	19	0	16	17	A	B	B	17	B	20	B	618	280	-	-	-	-
		EB	5013-5015	810	913	0	1723	691	751	0	1442	-119	-162	0	-281	22	22	0	C	C	A	22	C			331	280	331	240	-	-
	I-395 NB On-Ramp/Seminary Road (Node #5010)	NB	5015-5010	633	976	0	1609	572	923	0	1495	-61	-53	0	-114	8	7	0	A	A	A	7	A	10	A	276	140	276	180	-	-
		WB	5009-5010	0	309	0	309	0	327	0	327	0	18	0	18	0	20	0	A	B	A	20	B			160	120	-	-	-	-
	I-395 SB Off-Ramp/Seminary Road (Node #5012)	WB	1211-5012	304	738	0	1042	307	701	0	1008	3	-37	0	-34	9	9	0	A	A	A	9	A	14	B	300	100	300	100	-	-
		SB	2205-5012	0	632	0	632	0	537	0	537	0	-95	0	-95	0	23	0	A	C	A	23	C			281	220	-	-	-	-
	I-395 SB On-Ramp/Seminary Road (Node #5013)	SB	5012-5013	630	306	0	936	570	266	0	836	-60	-40	0	-100	9	9	0	A	A	A	9	A	10	A	259	140	259	140	-	-
		WB	5019-5013	0	1093	0	1093	0	884	0	884	0	-209	0	-209	0	10	0	A	B	A	10	B			357	160	-	-	-	-
MARK CENTER DRIVE	Mark Center Drive / Seminary Road (Node #5022)	WB 1	5021-5022	106	536	39	681	108	547	38	693	2	11	-1	12	66	15	11	E	B	B	23	C	54	D	243	140	243	160	-	-
		WB 2	5018-5022	0	1150	62	1212	0	1040	58	1098	0	-110	-4	-114	0	33	36	A	C	D	33	C			637	580	-	-	-	-
		NB	5060-5022	350	52	1311	1713	261	46	1001	1308	-89	-6	-310	-405	66	60	26	E	E	C	35	C			340	220	340	220	340	200
		EB	5023-5022	35	1920	59	2014	35	1609	65	1709	0	-311	6	-305	142	95	37	F	F	D	94	F			395	420	150		395	
		SB	5045-5022	187	10	71	268	179	11	70	260	-8	1	-1	-8	68	86	21	E	F	C	56	E			252		252		252	
N BEAUREGARD STREET	N. Beauregard Street / Seminary Road (Node #5025)	WB	5023-5025	605	1221	0	1826	547	1095	0	1642	-58	-126	0	-184	70	23	0	E	C	A	38	D	77	E	341	360	341	220	-	-
		NB	6004-5025	386	456	0	842	357	441	0	798	-29	-15	0	-44	178	51	0	F	D	A	107	F			347	360	175	160	-	-
		EB	5026-5025	106	1214	0	1320	84	1052	0	1136	-22	-162	0	-184	157	79	0	F	E	A	85	F			323	320	100	100	-	-
		SB	6002-5025	156	438	46	640	105	394	39	538	-51	-44	-7	-102	349	78	64	F	E	E	129	F			250	260	135	140	-	-
	N. Beauregard Street / Mark Center Drive (Node #6005)	WB	5032-6005	376	5	404	785	335	1	304	640	-41	-4	-100	-145	45	24	8	D	C	A	27	C	22	C	286	320	-	-	286	320
		NB	6007-6005	45	1010	54	1109	48	1028	44	1120	3	18	-10	11	71	15	12	E	B	B	17	B			329	260	150	120	-	-
		EB	5030-6005	72	20	31	123	79	15	26	120	7	-5	-5	-3	50	41	37	D	D	D	46	D			203	180	-	-	-	-
		SB	6004-6005	225	1350	15	1590	217	1217	0	1434	-8	-133	-15	-156	56	16	0	E	B	A	22	C			435	440	350	160	-	-

Results of the 2011 baseline operational analysis without BRAC improvements indicate some of the I-395 mainline and ramp sections serving Seminary Road interchange experiencing higher density values restricting lane changes and operating at unacceptable level of service. Many of the lane group movements at existing signalized intersections within the study area experienced severe delay under the projected demand operating at unacceptable levels of service. These degrading operations at the individual intersection approaches will eventually lead to the failure of the overall intersection. In addition, the overall intersection at the Seminary Road and North Beauregard Street intersection operated at unacceptable levels under the projected morning and evening peak hour demands, with all the intersection approaches and lane group movements experiencing severe delay. The Southeast rotary intersection serving the I-395 northbound exit ramp also operated at an unacceptable level under the projected morning peak hour demand.

Table 4-18 shows a comparative summary of the intersection levels of service for the morning and evening peak hours with and without BRAC 133 and IDA improvements for the opening year 2011. Table 4-18 intersections with the highest levels of congestion (LOS E and LOS F) have been highlighted for ease of reference.

Table 4-18: Comparative Analysis of the Intersection LOS for 2011 Baseline and Projected Morning & Evening Peak Hour Traffic Demand With and Without BRAC 133 and IDA Improvements[43]

Study Area	Corridor	Location	Approach	AM Peak – Baseline 2011 Without BRAC 133 & IDA: LOS By Approach	AM Peak – Baseline 2011 Without BRAC 133 & IDA: LOS By Intersection	AM Peak – Projected 2011 With BRAC 133 & IDA: LOS By Approach	AM Peak – Projected 2011 With BRAC 133 & IDA: LOS By Intersection	PM Peak – Baseline 2011 Without BRAC 133 & IDA: LOS By Approach	PM Peak – Baseline 2011 Without BRAC 133 & IDA: LOS By Intersection	PM Peak – Projected 2011 With BRAC 133 & IDA: LOS By Approach	PM Peak – Projected 2011 With BRAC 133 & IDA: LOS By Intersection
				Mark Center (BRAC 133) TMP USACE, 2010 AM PEAK ANALYSIS				Mark Center (BRAC 133) TMP USACE, 2010 PM PEAK ANALYSIS			
MARK CENTER (BRAC 133) TRAFFIC ANALYSIS STUDY AREA	LIBRARY LANE	Library Lane / Seminary Road Intersection (Node #5003)	WB	A	A	B	B	A	A	A	A
			NB	C		C		C		D	
			EB	A		A		A		A	
			SB	C		C		D		D	
	I-395 / SEMINARY ROAD ROTARY INTERCHANGE	I-395 NB Off Ramp / Seminary Road (Node #5015)	NB	D	E	E	E	B	C	B	B
			EB	E		F		C		C	
		I-395 NB On Ramp / Seminary Road (Node #5010)	NB	B	C	B	C	A	A	A	A
			WB	D		D		B		B	
		I-395 SB Off Ramp / Seminary Road (Node #5012)	WB	A	B	A	B	A	B	A	B
			SB	E		E		B		C	
		I-395 SB Off-Ramp (Free Right Turn)	SBRT	D	D	F	F	D	D	F	F
		Southwest Intersection (Node #5013)	SB	D	D	C	D	A	A	A	A
			EB	E		E		B		B	
		I-395 SB On-Ramp (Free Right Turn)	EBRT	D	D	D	D	E	E	F	F
	MARK CENTER DRIVE	Mark Center Drive / Seminary Road Intersection (Node #5022)	WB 1	C	C	F	D	B	C	C	D
			WB 2	B		C		C		C	
			NB	B		C		C		C	
			EB	B		C		B		F	
			SB	F		F		D		E	
	N. BEAUREGARD STREET	N. Beauregard Street / Seminary Road Intersection (Node #5025)	WB	C	E	D	E	D	E	D	E
			NB	F		F		F		F	
			EB	D		D		D		F	
			SB	D		F		E		F	
		N. Beauregard Street / Mark Center Drive (Node #6005)	WB	D	D	C	D	C	C	C	C
			NB	E		E		B		B	
			EB	E		D		E		D	
			SB	C		D		C		C	

[43] A third scenario was analyzed to identify the impacts of BRAC 133 traffic only (i.e., without the traffic from the IDA development). Results of the analysis for this scenario indicated only minor improvements in control delay values for signalized intersections within the study area, and a decrease in freeway and ramp densities. However, no significant change in LOS values for the freeway mainline, ramps, or signalized intersections was observed, with the exception of the I-395 NB GP lanes during the morning peak hour, which improved from LOS F to LOS E.

4.4.7 Projected Internal Circulation and Traffic Operations

Traffic simulation models developed for the Mark Center projected traffic condition show the proposed internal roadways operating at acceptable conditions with free flowing traffic throughout the internal roadways. The simulation model results were evaluated to identify traffic operations and levels of service for the proposed signalized intersection at Mark Center Drive and the proposed roundabout at WHS Circle/IDA Drive - North Parking Garage. The proposed roundabout within the Mark Center site was coded in as a one-way link circulating in a counterclockwise direction, with the roundabout approach legs controlled by yield signs. Conditional turn movements were used to accurately replicate Origin-Destination assignments of the left, through, and right turning movements. The output data from the multiple simulation runs were averaged for flow rate, control delay, average, and maximum queue lengths for approach movements. Table 4-19 shows the projected morning and evening peak hour traffic operations of the signalized intersection at Mark Center Drive and the roundabout at WHS Circle/IDA Drive-North Parking Garage.

Results from the above table indicate that the proposed internal roadway lane configurations and storage lengths adequately serve the site generated morning and evening peak hour traffic. In addition, the access control facilities at the South Parking Garage experience lesser peak hour vehicle demand than the maximum capacity of the proposed system. Hence, no traffic queues are expected to extend from the access control gates and adversely impact the internal roadway operations. The ACP also has a reserved inbound check-in lane that can be utilized during special scenarios when heavy inbound demand occurs.

Table 4-19: Traffic Operational Analysis of the Proposed Internal Roadway Network for 2011 Projected Morning & Evening Peak Hours

		Location	Approach	Link	Projected Demand				Model Throughput				Model Throughput vs Projected Demand				Control Delay By Movement			LOS By Movement			LOS By Approach		LOS By Intersection		Modelled Storage and Maximum Traffic Queuing (ft) Through		Left Turn		Right Turn	
					Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Left	Thru	Right	Delay	LOS	Delay	LOS	Link Length (ft)	Queue (ft)	Storage (ft)	Queue (ft)	Storage (ft)	Queue (ft)
MARK CENTER INTERNAL ROADWAYS	SIGNALIZED AM PEAK	Mark Center Drive / Mark Center Drive (Node #5033)	WB	35-5033	0	91	30	121	0	92	46	138	0	1	16	17	0	31	2	-	C	A	21	C	11	B	254	160	-	-	254	60
			NB	5031-5033	5	5	0	10	9	1	0	10	4	-4	0	0	27	11	0	C	B	-	26	C			265	40	-	-	-	-
			EB	5034-5033	734	944	92	1770	667	762	83	1512	-67	-182	-9	-258	9	8	4	A	A	A	8	A			167	180	167	180	-	-
			SB	5060-5033	177	41	59	277	125	38	49	212	-52	-3	-10	-65	24	19	7	C	B	A	19	B			533	120	533	140	-	-
	SIGNALIZED PM PEAK	Mark Center Drive / Mark Center Drive (Node #5033)	WB	35-5033	0	406	667	1073	0	410	594	1004	0	4	-73	-69	0	15	4	-	B	A	9	A	11	B	254	140	-	-	254	140
			NB	5031-5033	40	132	0	172	45	127	0	172	5	-5	0	0	18	17	0	B	B	-	17	B			265	120	-	-	-	-
			EB	5034-5033	357	130	11	498	217	63	7	287	-140	-67	-4	-211	18	18	8	B	B	A	18	B			167	120	167	160	-	-
			SB	5060-5033	18	10	243	271	15	8	181	204	-3	-2	-62	-67	9	11	4	A	B	A	5	A			533	20	533	120	-	-
	ROUNDABOUT AM PEAK [1]	WHS Circle/IDA Drive - North Parking Garage	EB	5033-35	258	608	255	1121	193	518	185	896	-	-90	-	-90							2	A			254	20				
			NB	5040-36	40	0	0	40	40	0	0	40		-	0	0							3	A			153	60				
			WB	5042-37	0	64	0	64	0	67	0	67	-	-	0	0							0	A			109	40				
			SB	5039-38	0	0	17	17	0	0	18	18	-	-	1	1							3	A			131	0				
	ROUNDABOUT PM PEAK [1]	WHS Circle/IDA Drive - North Parking Garage	EB	5033-35	258	608	255	1121	193	518	185	896	-	-90	-	-90							2	A			254	0				
			NB	5040-36	40	0	0	40	40	0	0	40		-	0	0							1	A			153	20				
			WB	5042-37	0	64	0	64	0	67	0	67	-	-	0	0							0	A			109	60				
			SB	5039-38	0	0	17	17	0	0	18	18	-	-	1	1							3	A			131	0				

NOTE:

1. Average control delay values in seconds per vehicle can be measured for individual approaches only and not for the whole roundabout intersection.

4.4.8 Projected Problem Areas

Traffic operational analysis and simulation modeling results for the projected condition morning and evening peak hour demand indicated locations of concern throughout the study area roadway network that were marked by long traffic queues and spillovers. The LOS at these locations deteriorated to an unacceptable E or F, with demand exceeding capacity. Some of the notable locations that require improvements are shown below.

Along Interstate Mainline and Ramps:

- I-395 Northbound GP lanes south of the Seminary Road interchange and the Seminary Road exit ramp section
- I-395 Southbound GP lanes north of the Seminary Road interchange and the Seminary Road exit ramp section
- Seminary Road entrance ramp section to southbound I-395

Projected traffic queue spillback along southbound I-395 extends north past the King Street interchange, affecting the entrance ramp operations and weave section maneuvers from King Street. The extents of the northbound queue spillback and its impact on Duke and Seminary Road interchange operations should be evaluated.

Along Arterial Streets and Intersections:

- Southeast rotary intersection that controls the I-395 northbound exit ramp approach - identified as the primary cause of projected traffic congestion along southbound I-395 and eastbound Seminary Road
- North Beauregard Street and Seminary Road intersection - the heavy left turn demands from conflicting intersection approaches result in an inadequate allotment of green time splits that affects the capacity and operations of the overall intersection
- Eastbound Seminary Road queue spillback due to degrading traffic operations at the southeast rotary intersection

Other Concerns causing Traffic Operational Problems:

- Short distance weaving maneuvers executed by the following turn movements create vehicular conflicts and impedance of through traffic flow
    - Right turns from northbound North Beauregard Street to eastbound Seminary Road
    - Right turn movements from westbound Seminary Road to Southern Towers
    - Left turn movements to North Beauregard Street from northbound and southbound I-395 exit ramps
    - Right turn movements from eastbound Seminary Road to North Beauregard Street and making left turns into Mark Center Drive

- Existing lane configurations along Seminary Road have multiple lane merges and splits occurring over short distances at the following locations that require quick driver decision-making and reaction skills. Unfamiliar drivers and familiar drivers with slow reaction times who fail to execute these merge and lane change maneuvers in timely fashion may block traffic and impede traffic operations
    - I-395 exit ramp traffic merging with westbound Seminary Road traffic and positioning for executing left turns to head southbound on North Beauregard Street
    - Eastbound Seminary Road traffic positioning for the I-395 northbound or southbound entrance ramps

In addition, the traffic demand at many of the intersection approach movements within the study area exceed available capacity resulting in spillover and traffic overflow that extends into downstream intersections impeding corridor wide traffic flow and operations.

4.4.9 Suggestions that Require Further Review and Analysis

The locations identified in the previous section were assessed for potential improvements that would help improve overall operations. After review of the traffic characteristics and travel patterns from the simulation models under the projected demand conditions, preliminary improvements were identified that require further review and validation. Some of the proposed recommendations are long-term by nature, due to the associated costs and funding approval. Extensive coordination between participating agencies including VDOT, City of Alexandria, USACE, and other agencies in the surrounding jurisdictions is required in the identification of specific improvements and their implementation.

Suggested Roadway Improvements:

1. Widen the existing single lane approach from I-395 north and south exit ramp traffic movements going westbound on Seminary Road, to two lanes. This significantly improves the southbound I-395 mainline and ramp operations at the Seminary Road interchange.

2. Widen northbound I-395 exit ramp approach to allow a longer two-lane wide ramp section. This adds more capacity to the ramp and helps mitigate some traffic congestion along I-395. However, this can only be a short-term improvement since the traffic queues are attributed to the inadequacy of the downstream rotary intersection.

3. Reconfigure the existing southbound I-395 entrance ramp from Seminary Road, and the ramp merge influence area to add capacity. The existing entrance ramp from Seminary Road tapers from a double lane to a single lane ramp before entering the freeway section via a 200 ft acceleration lane. The projected traffic demand requires a longer merge section.

Suggested Intersection Improvements:

1. One long-term possibility could be to eliminate northbound left turns from the Seminary Road and North Beauregard Street intersection by constructing a three phase- signalized intersection at Foster Avenue for the redirected left turns. This will limit the number of signal phases at

North Beauregard Street and Seminary Road intersection and improve overall intersection capacity and corridor operations along Seminary Road and North Beauregard Street. This improvement requires the following concurrent capacity and traffic control modifications to obtain the required results without causing any adverse traffic operational impacts along North Beauregard corridor.

a. Widen North Beauregard Street to receive four lanes of traffic at Foster Avenue with the two inside lanes operating as dedicated left turns.

b. Widen and improve Foster Avenue to receive two lanes of one-way traffic and provide a direct merge to Seminary Road.

c. Widen Seminary Road at the Fosters Avenue merge location to receive two additional full lanes; the added lanes should be tapered gradually to meet the existing lane geometry to allow smooth merging and eliminate any potential bottleneck.

d. Restripe the two northbound dedicated left turn lanes at the Seminary Road and North Beauregard Street intersection as through lanes.

e. Eliminate all southbound left turns from North Beauregard Street into Southern towers at the proposed Foster Avenue intersection location and redirect them to execute left turns at Seminary Road and North Beauregard Street intersection to access Southern Towers via Mark Center Drive. Additional capacity and signal timing review required to identify the impacts of this added traffic at Seminary Road and Mark Center Drive intersection.

f. Revise signage such that the right turns from Southern Towers to North Beauregard Street are yield-controlled.

g. Coordinate signal timing operations of the proposed signal with the existing signals along Beauregard corridor.

2. Optimize signal timing and coordination at the rotary interchange with the coordinated cycle length determined based on the demand experienced at the southeast rotary interchange.

3. Install advance warning signs, lane guidance regulatory signs, informational guide signs and highly visible pavement markings along Seminary Road at I-395 ramp split locations to aid in advance decision making, and minimize vehicular conflicts.

4. Provide exclusive bus bays at all existing bus stop locations to prevent blocking of through traffic by stopped buses.

Suggested Traffic Control Improvements:

1. Optimize signal timing and coordination along Seminary Road to serve the projected demand.

2. Modify east-west signal coordination along Seminary Road by coordinating the westbound through movement at Mark Center Drive intersection and the westbound left turn movement at

North Beauregard Street intersection. This will help clear Seminary Road at Mark Center Drive and North Beauregard Street intersections and reduce traffic queues, since most of the westbound through traffic exiting Seminary Road and Mark Center Drive intersection execute left turns to travel on North Beauregard Street. This will also improve the flow of the I-395 ramp traffic movement and minimize backups along I-395 mainline and ramps.

3. Improve existing pedestrian crossing signal equipment to include new countdown pedestrian signal heads, push buttons, audible pedestrian signals, and pedestrian signage that meet ADA and MUTCD guidelines to adequately inform and serve the projected pedestrian traffic.

Recommended Internal Circulation Improvements within the Mark Center:

Install MUTCD recommended "Do Not Block Intersection" (R10-7) signs along the Mark Center internal roadway network intersection crossings, especially at exit points from parking garages, to keep traffic from joining stopped queues and obstructing other intersection approaches from discharging.

Other On-Going Studies:

1. VDOT is currently exploring the feasibility of a direct HOV access ramp from I-395 South to Seminary Road which would benefit BRAC 133 traffic and improve interchange traffic operations. The study is in its conceptual stage and it will take multiple years to identify funding sources, secure funding, design, and construct the project.
2. VDOT is currently analyzing short-term roadway and signal improvements recommended by the BRAC Advisory Group to determine the feasibility of implementation.

Figures 4-8 and 4-9 show details of the proposed suggestions to the adjacent roadway network.

Figure 4-8: Suggested Adjacent Roadway Improvements

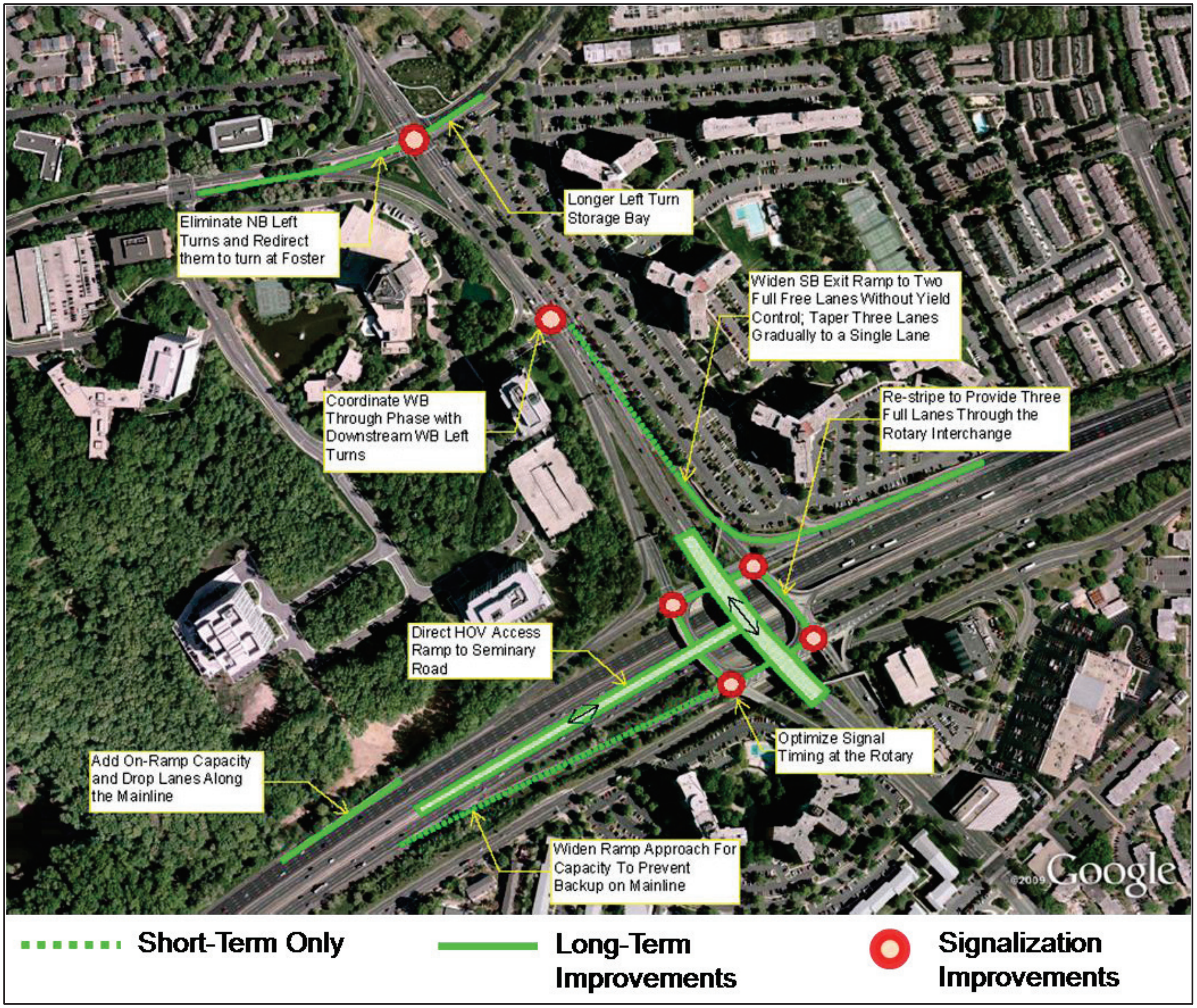
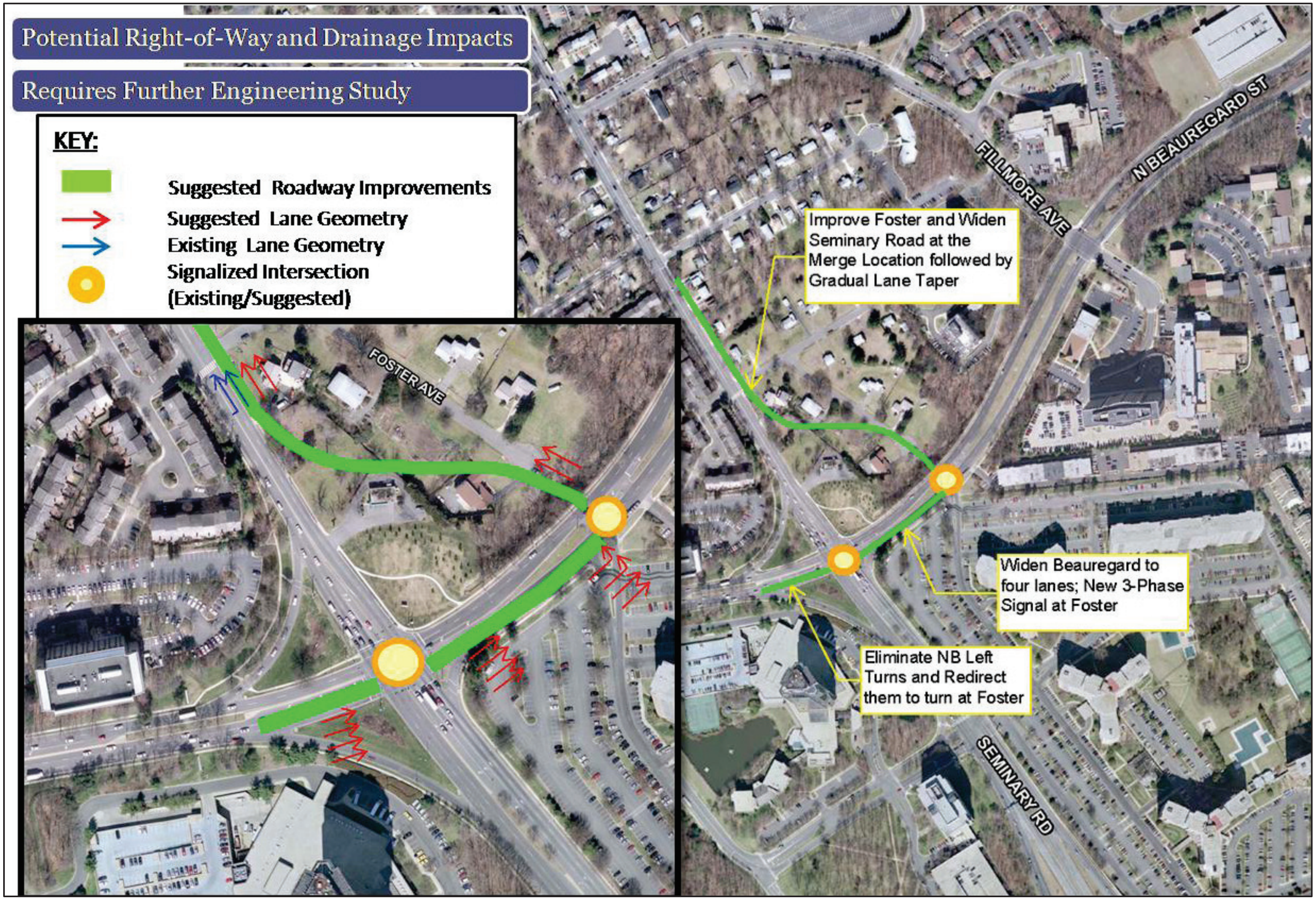


Figure 4-9: Suggested Adjacent Roadway Improvements (cont'd)



4.5 Impacts on Employees and Residents

4.5.1 Citizen and Neighborhood Associations

The following are concerns that have been articulated by citizens and neighborhood associations in the vicinity of BRAC 133. This study did not examine or attempt to validate the concerns and/or assumptions made by citizens, nor has an effort been made reference any studies that may validate citizen assumptions. The following serves as a list of documented citizen concerns and assumptions to which stakeholders (i.e., DoD, the City of Alexandria, VDOT, etc.) are currently working together to address.

The primary concern of the citizens and neighborhood communities is the addition of about 3,800 new vehicular trips to the BRAC 133 location and its traffic impacts on the surrounding roadway network. Another concern was the fear that the provision of free employee parking at the site would encourage more SOV trips to the site and ultimately result in parking overflow. Reduction of site-generated SOV trips by more than 40 percent was suggested for consideration. Other concerns include current lack of an extensive shuttle service plan and shuttle service amenities, internal roadway circulation, pedestrian and bicycle traffic circulation and safety, access control point processing and traffic backups, and lack of a comprehensive intermodal plan for the region. USACE and its affiliated organizations are working in close coordination with the City staff and the BRAC Advisory Group to identify their concerns and take appropriate action.

In response to the already raised citizen and neighborhood concerns, the Army is making or has already made the following transportation improvements or plan changes to meet their demands:

1. Implement interim roadway and traffic control improvements identified and approved as part of the 2003 TIS/TMP to improve roadway capacity and traffic operations.
2. Eliminate left turns from I-395 exit ramp traffic at Mark Center Drive and Seminary Road intersection by constructing a physical barrier obstruction to reduce vehicular conflicts and minimize short distance lane change maneuvers.
3. Propose TDM strategies that account for 40 percent or more reduction in site-generated SOV trips.
4. Develop a pedestrian circulation and sidewalk plan that includes improvement to the existing sub-standard sidewalks, ADA ramps and crosswalks to meet ADA guidelines, continuity to the existing sidewalk system and connectivity to major activity centers.
5. Relocate visitor control center to the South Campus from its previous north campus location to minimize impacts of any traffic queues extending from the VCC and affecting Mark Center Drive and Seminary Road intersection operations.
6. Restrict site access control point (ACP) and verification guard booths to the South Campus location to minimize impacts of any traffic queues extending from the access control gates from affecting the traffic operations along North Beauregard Street and Mark Center Drive.

7. Construct a pedestrian bridge connecting North and South Parking Garages to help transport employees and visitors to the south ID verification and security checkpoint before entering into the facility. Restricting North Garage entering employees and visitors to use the pedestrian bridge for accessing the security and ID verification point eliminates potential traffic queues that may have originated from providing a second ACP at the North Parking Garage entrance.
8. Use Army recommended access control processing equipment with faster processing rates to adequately serve the peak hour arriving vehicular demand.
9. Provide multiple DoD/WHS shuttle bus services from the Pentagon Transit Center, Metrorail stations serving Blue, Yellow and Orange lines, and Virginia Rail Express (VRE) stations during the morning and evening peak periods of travel to promote Metrorail use and non-SOV site trips.
10. Provide a Transportation Center with five bus bays that will offer short-term parking for DoD shuttles and provide facilities for shuttle bus drivers.

The projected trip origin and distribution patterns and traffic operational analysis concerns raised by the citizens and neighborhood communities are being addressed in the TMP document. In addition, the short-term roadway improvements recommended by the BRAC Advisory Group staff were reviewed for feasibility. Some of the recommendations identified by the BRAC Advisory Group staff match the TMP proposed recommendations and should be further studied for implementation.

4.5.2 Employee Concerns

The comments obtained from the WHS commuter survey respondents were summarized to identify the primary concerns of the relocating employees to the BRAC 133 site. Many of the employees were uncertain of their proposed future travel patterns and mode choices since they had not yet been briefed on all the available transportation options to access BRAC 133. Some of the primary concerns expressed by employees include the lack of attractive public transportation/Metrorail to BRAC 133, existing congestion along I-395 corridor, the lack of direct HOV access from I395 South at Seminary Road interchange, lack of information on the DoD shuttle bus plan (including frequency of shuttle service, bus sizes, bus headways and serviced Metrorail stations), pedestrian and bicycle facilities, shuttle bus service during mid-day and off peak hours, parking restriction and management, slugging, emergency vehicle access, telecommuting and flexible work schedules. The traffic impacts from the proposed Mark Center site and the mitigation efforts in progress are outlined below.

1. The proposed development at BRAC 133 is expected to generate 57 percent drive-alone vehicle trips and 11 percent ride-share vehicle trips that include carpools, vanpools, and shuttle buses. The total development at BRAC 133 and IDA adds a total of about 2,000 new AM peak hour trips, and 1,900 new PM peak hour trips to the existing roadway network surrounding Mark Center. Forty-eight percent of all the new trips are projected to use I-395, with 19 percent from the north and 29 percent from the South.

2. Interim roadway improvements including roadway widening and traffic signal modifications are scheduled for completion before September 15, 2011 and will improve capacity and traffic operations. However, the Seminary Road exit ramps from I-395 north and south directions will

operate at unacceptable levels with traffic queues and congestion extending to the mainline. Traffic will also experience some delays at the Seminary Road and North Beauregard Street signalized intersection.

3. A currently on-going VDOT study to develop alternatives for providing a direct HOV access from I-395 South to Seminary Road is being reviewed by FHWA, VDOT, and other agencies for feasibility and funding. If approved, this improvement will reduce congestion on I-395 and provide direct HOV access to the site. In addition, other short term improvements recommended by the BRAC Advisory Group are also being reviewed and analyzed by VDOT for feasibility. The TMP also identifies short and long-term suggestions that require further review and analysis.

4. Long-term studies to widen I-395 between Duke Street and King Street interchanges are also being evaluated and studied by VDOT. However, the approval process and securing of federal funds may be time consuming.

5. Rideshare trips from I-395 South have the option to travel on I-395 HOV lanes, exit at the Pentagon, and use DoD shuttles to travel to Mark Center site.

6. Multiple DoD/WHS shuttle buses operating at 10 or 15 minute headways will serve BRAC 133 employees from the Pentagon Transit Center, the King Street Metrorail Station, Ballston, West Falls Church, and Franconia-Springfield Metrorail stations during the morning and evening peak periods of travel. Shuttle buses will operate off-peak service to the Pentagon every 15 minutes and off-peak service to Franconia-Springfield every 30 minutes. Shuttle service will be offered for 14 hours a day, from 5:30 AM to 7:30 PM. The proposed shuttle plan is flexible and will be modified for bus sizes and headways as per employee demand once the facility is open and operational.

7. Some Government vehicles may be made available by individual organizations for employee mid-day travel to off-site meetings.

8. A detailed pedestrian circulation and sidewalk plan that includes improvements to the existing walkway system (including, ADA ramps, crosswalks and pedestrian walkway facilities), provides continuity to the existing walkway system and connectivity to major activity centers is being implemented to promote pedestrian travel.

9. Bike racks and shower facilities with lockers are being provided at the site to serve employees who bike to work and to promote non-motorized mode of travel.

10. A slug lane with a pedestrian refuge area is being provided to anticipate slugging among employees.

11. Proposed Transportation Center with five bus bays will offer short-term parking and waiting area for DoD shuttles with facilities for shuttle bus drivers. A covered pedestrian bridge will safely transport employees entering or exiting the BRAC 133 complex to the North Parking Garage and the Transportation Center.

12. A total of 3,530 parking spaces will be available for employees with the exception of government vehicle and visitor parking spaces. A total of 320 priority designated parking spaces will be allotted for rideshare vehicles including carpools and vanpools. Alternative fuel vehicles will be allotted 192 designated parking spaces. A total of 48 ADA parking spaces will be located closer to the entry point for easy access. Parking spaces will be distributed to tenant organizations as per their employee ratios. Tenant organizations will be ultimately responsible for designating employees to receive parking permits. Parking permits will be assigned by parking garage to eliminate added internal circulation trips between the North and South Garages.

13. Telecommuting and flexible work schedules are being recommended for enforcement by tenant organizations to assist commuters and reduce traffic congestion problems.

Detailed discussions on TDM strategies including transit service, WHS/DoD shuttle plan alternatives, rideshare promotions and matching, public and private transit service, and parking management are included in the following Section 5.